JAPANESE [JP,07-226224,A]

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] Are the fuel supply system which supplies this hydrogen gas, and steam reforming of the hydrocarbon compound is carried out to the fuel cell which makes hydrogen gas fuel gas. A reforming means to generate hydrogen gas in the state of mixture of a steam, and a supply means to supply the this generated hydrogen gas to said fuel cell with said steam, The fuel supply system of the fuel cell characterized by having an amount accommodation means of steam mixture to adjust the amount of steam mixture in the hydrogen gas which removes said steam in the path of the this hydrogen gas supplied, and is supplied to said fuel cell.
[Claim 2] The fuel supply system of a fuel cell equipped with an operational status detection means to be the fuel supply system of a fuel cell according to claim 1, and to detect the operational status of said fuel cell, a damp or wet condition judging means to judge the damp or wet condition of said fuel cell based on the this detected operational status, and the control means that controls said amount accommodation means of steam mixture according to the this judged damp or wet condition.
[Claim 3] It is the fuel supply system of the fuel cell which has the temperature control section which is the fuel supply system of a fuel cell according to claim 1, and controls the internal temperature of the buffer container with which said amount accommodation means of steam mixture is formed in the path of said hydrogen gas, and hydrogen gas flows with a steam, and this buffer container.
[Claim 4] It is the fuel supply system of the fuel cell which is the fuel supply system of a fuel cell according to claim 3, and is what said buffer container is constituted so that heat exchange can perform the fluid path which the oxygen content gas supplied to said fuel cell passes between the interior of a container, and controls said oxygen content capacity to which said temperature control section passes said fluid path.

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the fuel supply system which supplies this hydrogen gas to the fuel cell which makes hydrogen gas fuel gas.
[0002]
[Description of the Prior Art] Generally, the fuel cell which makes hydrogen gas fuel gas has the electrolyte and electrode which penetrate a hydrogen ion in the state of the hydration of H+ (xH2O), makes the catalyst bed for promoting electrode reaction intervene, and is pinched and equipped with this electrolyte with an electrode. Although such a fuel cell has various things (for example, a polymer electrolyte fuel cell, a phosphoric acid mold fuel cell, etc.) according to the class of electrolyte to be used, the electrode reaction which a difference does not have in the electrode reaction which advances in a positive-negative electrode, and advances on each pole is as follows.
Cathode (hydrogen pole): 2H2 ->4H++4e- --** anode plate (oxygen pole): 4H++4e- +O2 ->2H2O -- ** [0003] And if the hydrogen gas which is fuel gas is supplied to cathode, in cathode, the reaction formula of ** will advance and a hydrogen ion will generate. If this generated hydrogen ion penetrates an electrolyte (if it is a polymer electrolyte fuel cell solid-state polyelectrolyte film) in the state of the hydration of H+ (xH2O) (diffusion), and reaches an anode plate and oxygen content gas, for example, air, is supplied to this anode plate, the reaction formula of ** will advance in an anode plate. A fuel cell will present electromotive force because the electrode reaction of this ** and ** advances on each pole.
[0004] The electrolyte of a fuel cell will be in the condition that moisture runs short on the convenience which penetrates an electrolyte to an anode plate side (diffusion), and by the cathode side from a cathode side in the state of the hydration which the hydrogen ion described above. Moreover, although the solid-state polyelectrolyte film used for a polymer electrolyte fuel cell will demonstrate good electrical conductivity (ion conductivity) if it is in a moderate damp or wet condition, if water content falls, ion conductivity will get worse, and it stops functioning as an electrolyte, and will stop electrode reaction depending on the case. Moreover, even if water content is too high, there is an inclination for ion conductivity to get worse. For this reason, while supplying the hydrogen gas as fuel gas to cathode, it is necessary to always supply a suitable quantity of water.

Therefore, the hydrogen gas humidified with the steam is supplied to the fuel cell from the fuel supply system.
[0005] In order to supply the hydrogen gas by which steam humidification was carried out from the fuel supply system to a fuel cell, there are various approaches and the following techniques are well known as simplest approach. That is, in carrying out steam reforming of the hydrocarbon compounds, such as a methanol, and generating hydrogen gas, since reforming ****** of a methanol and water is an equimolar reaction, it is the approach of humidifying hydrogen gas with the steam of the amount which supplies excessive water a little to a methanol, is made to cause a reforming reaction, and is equivalent to excessive water. Moreover, in JP,3-269955,A, heat exchange of the generated hydrogen gas is carried out, it is lowered, a steam is added before a fuel cell in the hydrogen gas after a temperature fall, and the technique which supplies the hydrogen gas humidified by steaming to a fuel cell is proposed.
[0006]
[Problem(s) to be Solved by the Invention] However, in supplying excessive water a little to a methanol, making a reforming reaction cause in the state of the excess of moisture and humidifying, there are the following faults. For example, when it fixes the amount of redundant water, in order to avoid the lack of humidification of a fuel cell, it is necessary to supply with a steam the moisture maximum needed for the time of a generation of electrical energy of a fuel cell. therefore -- although it is necessary to supply the redundant water of a quantum and to make a reforming reaction cause -- changing the water vapor content in hydrogen gas depending on advance extent of a reforming reaction **** -- the generation-of-electrical-energy condition of a fuel cell -- moisture -- being excessive -- becoming -- an electrolyte membrane -- being the so-called -- getting wet -- passing -- ** -- a sake -- electrode reaction -- falling -- cell performance degradation -- inviting -- things -- it is .
[0007] Moreover, although it is also possible to adjust the water vapor content in hydrogen gas, i.e., humidification extent of a fuel cell, through the increase and decrease of accommodation of the amount of the water used for a reforming reaction, it is not realistic from the following reasons. That is, since the mol number of water decreases to a methanol in performing accommodation of the amount of feedwaters to a reduction side, the increase of the occurrence frequency of the carbon monoxide which is the intermediate product of a reforming reaction, and this carbon monoxide will be supplied to the cathode of a fuel cell. Thus, if a carbon monoxide reaches cathode, poisoning of the catalyst of a catalyst bed established in order to promote electrode reaction will be carried out with a carbon monoxide, and the function as a catalyst will fall. For this reason, a halt of electrode reaction, as a result the shutdown of a fuel cell are caused.
[0008] on the other hand, it is proposed by JP,3-269955,A -- as -- the temperature of reformed gas -- the temperature of a fuel cell, and abbreviation -- it was difficult to lower to same extent, and for both the heat exchanger for lowering temperature and the humidifier which adds water to be needed for the lowered reformed gas with the technique which adds water separately, and to attain miniaturization of a system. Moreover, when the heat exchanger was

excluded simply, it originated in the temperature of the reformed gas supplied to a humidifier being an elevated temperature (about 250-300 degrees C), and there was a problem that controlling in the desired humidification condition became difficult. For example, when the bubbler which is a common humidifier was used, since reformed gas was rapidly cooled with the water in a bubbler, the moisture which reformed gas holds was added in the bubbler, the water management of a bubbler became difficult, and also the temperature of the water in a bubbler itself was influenced with reformed gas, and there was a problem of being hard coming to control the amount of humidification.

[0009] This invention is made in order to solve the above-mentioned trouble, and it aims at attaining stabilization of the output of the fuel cell which makes hydrogen gas fuel gas.

[0010]

[Means for Solving the Problem] The means adopted with the fuel supply system of the fuel cell according to claim 1 for attaining this purpose Are the fuel supply system which supplies this hydrogen gas, and steam reforming of the hydrocarbon compound is carried out to the fuel cell which makes hydrogen gas fuel gas. A reforming means to generate hydrogen gas in the state of mixture of a steam, and a supply means to supply the this generated hydrogen gas to said fuel cell with said steam, Said steam is removed in the path of the this hydrogen gas supplied, and let it be the summary to have an amount accommodation means of steam mixture to adjust the amount of steam mixture in the hydrogen gas supplied to said fuel cell.

[0011] In this case, in the fuel supply system of a fuel cell according to claim 2, it has an operational status detection means to detect the operational status of said fuel cell, a damp or wet condition judging means to judge the damp or wet condition of said fuel cell based on the this detected operational status, and the control means that controls said amount accommodation means of steam mixture according to the this judged damp or wet condition.

[0012] Moreover, in the fuel supply system of a fuel cell according to claim 3, said amount accommodation means of steam mixture is formed in the path of said hydrogen gas, and it has the buffer container with which hydrogen gas flows with a steam, and the temperature control section which controls the internal temperature of this buffer container.

[0013] In this case, said buffer container is constituted so that heat exchange can perform the fluid path which the oxygen content gas supplied to said fuel cell passes between the interior of a container, and said temperature control section controls said oxygen content capacity which passes said fluid path by the fuel supply system of a fuel cell according to claim 4.

[0014]

[Function] In the fuel supply system of the fuel cell according to claim 1 which has the above-mentioned configuration, first, steam reforming of the hydrocarbon compound is carried out with a reforming means, and hydrogen gas is generated in the state of mixture of a steam. Although this generated hydrogen gas is supplied to a fuel cell with a steam by the supply means, in that path, the amount of steam mixture in hydrogen gas is certainly adjusted through removal of the steam by the

amount accommodation means of steam mixture. Therefore, since the moisture in the hydrogen gas supplied to a fuel cell is intermingled as a steam, without waterdrop-izing, water is not supplied to a fuel cell with hydrogen gas as waterdrop.
[0015] In the fuel supply system of a fuel cell according to claim 2, the damp or wet condition of a fuel cell is judged with a damp or wet condition judging means based on the operational status of the fuel cell which the operational status detection means detected. And since an amount accommodation means of steam mixture to adjust the amount of steam mixture in hydrogen gas is controlled by the control means according to the damp or wet condition of a fuel cell, according to the damp or wet condition of a fuel cell, the amount of steam mixture in hydrogen gas can be adjusted. Therefore, the excess of moisture is cancelable with the moisture as a steam adjusting the amount of steam mixture few, if the damp or wet condition of a fuel cell is the excess of moisture. The lack of moisture is cancelable with the moisture as a steam, adjusting many amounts of steam mixture on the other hand, if moisture is insufficient.
[0016] In the fuel supply system of a fuel cell according to claim 3, since the internal temperature of a buffer container prepared in the path of hydrogen gas is controlled by the temperature control section, the steam in the hydrogen gas which flows into a buffer container with a steam is removed within this buffer container, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted.
[0017] it is alike, the fluid path for which the oxygen content gas supplied by the fuel cell passes a buffer container is made [for which heat exchange can be performed between the interior of a buffer container / which was constituted] good, and the oxygen content capacity which passes a fluid path is controlled by the fuel supply system of a fuel cell according to claim 4 by the temperature control section. Therefore, the internal temperature of a buffer container is controlled through heat exchange with oxygen content gas, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted. For this reason, the temperature of oxygen content gas can also be adjusted with accommodation of the amount of steam mixture in hydrogen gas.
[0018]
[Example] Next, the suitable example of the fuel supply system of the fuel cell concerning this invention is explained based on a drawing. Drawing 1 is the block diagram of the fuel cell system which applied the fuel supply system of an example.

[0019] It has the fuel cell system 10 of an example centering on a polymer electrolyte fuel cell (it is hereafter called PEFC for short) 12, and the hydrogen gas obtained by the air which is oxygen content gas carrying out steam reforming of the methanol from the hydrogen gas supply duct 16 is supplied to PEFC12 from the oxygen gas supply line 14, respectively. The buffer tank 18 which adjusts the amount of steam mixture in hydrogen gas, and the methanol reformer 20 are formed in the duct of the hydrogen gas supply duct 16. In addition, although the check valve is prepared in both the above-mentioned ducts in the proper part, since it is not directly related to the summary of this invention, it is not illustrated.

[0020] PEFC12 is pinched and equipped with the solid-state polyelectrolyte film with a positive-negative electrode, and advances electrode reaction of above ** and ** in a positive-negative electrode in response to supply with the air to an anode plate, and the hydrogen gas to cathode. And PEFC12 drives the motor in an external driver, for example, an electric vehicle, through wiring 22 and 24 with the electromotive force pass the electrode reaction concerned.
[0021] The methanol reformer 20 receives supply of a methanol from the methanol tank 26 with the feeding pump 28, and receives supply of water from a water tank 30 with the feeding pump 32. And the methanol reformer 20 advances the reforming reaction of a methanol and water at the temperature of 250-300 degrees C through a reforming catalyst, carries out steam reforming of the methanol, and generates hot (before or after about 260 degrees C) hydrogen gas in the state of mixture of a steam. This generated hydrogen gas is sent out to the buffer tank 18 of that lower stream of a river.
[0022] Thus, in supplying water to the methanol reformer 20 from a water tank 30, the water of a little excessive amount is supplied to the methanol so that it may explain below. That is, the amount of supply of the water to the methanol reformer 20 is defined so that it may remain as a steam in the hydrogen gas which steam reforming of the water supplied to the methanol reformer 20 is carried out, and it generates by the methanol reformer 20 and may increase more than the maximum water vapor content for which the amount of survival (the amount of steam mixture) may moreover be needed at the time of the drive of PEFC12 (at the time of a generation of electrical energy) a little. If it puts in another way, even if hydrogen gas temperature descends to the temperature approximated to the operating temperature (80-100 degrees C) of about 260 degrees C to PEFC12, for example, 80 degrees C, the water of a little excessive amount is supplied to extent from which the steam in the hydrogen gas in the temperature can be in a saturation state to the methanol.
[0023] The buffer tank 18 by which hydrogen gas is sent out from the methanol reformer 20 has the temperature regulatory mechanism which adjusts the temperature inside a tank, lets the operation control of this temperature regulatory mechanism by the electronic control mentioned later pass, and controls the interior temperature of a tank. In this case, hot (before or after about 260 degrees C) hydrogen gas is sent to the buffer tank 18 from the methanol reformer 20, and, as for the hydrogen gas temperature supplied to PEFC12 from the buffer tank 18, it is desirable that it is the temperature approximated to the operating temperature (80-100 degrees C) of PEFC12. For this reason, the buffer tank 18 is equipped with the following configurations as a temperature regulatory mechanism which used cooling media, such as water and air.
[0024] As shown in drawing 2 , the buffer tank 18 plugs up the vertical edge of the metal body container section 40 with the up covering section 42 and the lower covering section 44, it makes O ring 46 intervene, binds these tight watertight with a bolt 48, and is formed. The gas installation port 50 is established in the up covering section 42, and the port concerned is connected with the methanol reformer 20. Moreover, the gas discharge port 52 is established in the up covering

section 42, and the port concerned is connected with PEFC12. For this reason, the hydrogen gas which hot hydrogen gas flowed into the buffer tank 18 interior in the state of mixture of a steam from the methanol reformer 20 through the gas installation port 50, and flowed in the tank will be supplied to PEFC12 through the gas discharge port 52. Furthermore, attachment immobilization of the Tanggu temperature sensor 53 which detects the temperature of the buffer tank 18 interior is carried out at the up covering section 42. In addition, this Tanggu temperature sensor 53 is connected to the below-mentioned electronic control 70.

[0025] On the other hand, the water discharge port 56 for discharging the water 54 solidified and liquefied inside the buffer tank is established in the lower covering section 44, and it gets down, and as shown in drawing 1 , this water discharge port 56 makes the pump 58 for circulation intervene, and is connected with the water tank 30 by the water cycle duct 60. For this reason, the water 54 which piled up in the buffer tank 18 interior is returned to a water tank 30 with the pump 58 for circulation, and it circulates through it as water supplied to the methanol reformer 20. In addition, the above-mentioned hydrologic cycle is intermittently performed by the intermittent drive of the pump 58 for circulation for every predetermined time.

[0026] It is formed in the side attachment wall of the body container section 40 so that the cooling-medium passage 62 through which cooling media, such as water and air, pass may enclose the interior of a container. Therefore, if a cooling medium flows into the cooling-medium passage 62 through the external piping 63 from the input which is not illustrated and a cooling medium passes through the passage concerned, heat exchange will break out between the cooling medium concerned and the hydrogen gas of the buffer tank 18 interior. For this reason, it is possible to control the interior temperature of a tank through the control of the temperature of a cooling medium or through put (per unit time amount flow rate) which passes through the cooling-medium passage 62, i.e., to control hydrogen gas temperature. In addition, this cooling-medium passage 62 may be formed according to an individual independently of ****** passage, and may be formed spirally.

[0027] The septum 64 of the porosity which divides the interior of a tank up and down is formed in the interior of the body container section 40, and the up space divided by this septum 64 is filled up with the metal with high thermal conductivity, or the spherical packing object 66 of a ceramic. For this reason, heat exchange of the hot hydrogen gas of the steam mixture condition which flowed through the gas installation port 50, and the cooling medium which passes through the cooling-medium passage 62 is efficiently performed through the spherical packing object 66 of the up space of the septum 64 upper part. Moreover, the body container section 40 is covered with the heat insulator 68 in the periphery, and emission of the heat from body container section 40 side attachment wall to the exterior is intercepted.

[0028] Therefore, if hot (before or after about 260 degrees C) hydrogen gas flows into the buffer tank 18 which has the above-mentioned structure in the state of mixture of a steam, in the buffer tank 18 interior, it will be cooled through heat exchange with a cooling medium, and this hot hydrogen gas will be made into the

temperature of the cooling medium which passes through the cooling-medium passage 62, or the temperature specified with that through put. By cooling of this hydrogen gas, the steam in hydrogen gas will be solidified in the buffer tank 18 interior about the part exceeding the amount of saturated steam in the hydrogen gas temperature after cooling (interior temperature of a tank), and will serve as waterdrop, and a steam will exist by the saturation state in hydrogen gas. The flow rate of the cooling medium which passes through the cooling-medium passage 62 becomes settled with the control signal from an electronic control, and accommodation is made whenever [flow control, i.e., tank internal temperature,] by carrying out drive control of the positive crankcase ventilation valve 65 prepared in the external piping 63 connected to the cooling-medium passage 62 of the buffer tank 18. In addition, the solidified waterdrop passes the hole of a septum 64, falls to the lower space of septum 64 lower part, and is returned to a water tank 30 from the water discharge port 56.

[0029] The fuel cell system 10 is equipped with the cell side temperature sensor 72 which, in addition to this, detects the temperature near the joint of the electronic control 70 for controlling the interior temperature of a tank in the buffer tank 18, and the solid-state polyelectrolyte film and electrode (cathode) in PEFC12, the voltmeter 74 which detects the output voltage of PEFC12, and the impedance meter 76 which detects an impedance. This electronic control 70 is constituted as a logic operation circuit focusing on CPU, ROM, and RAM, and performs I/O with the exterior by the input port and the output port which were mutually connected through these and a common bus. In the fuel cell system 10 of this example, an electronic control 70 carries out drive control of the positive crankcase ventilation valve 65 of the buffer tank 18 that the input of the impedance Z of the interior temperature TTANK of a tank of the buffer tank 18, the temperature TPEFC near the electrolyte membrane of PEFC12, and the output voltage V and PEFC12 of PEFC12 should be received, and the internal temperature of the buffer tank 18 should be adjusted from the Tanggu temperature sensor 53, the cell side temperature sensor 72, a voltmeter 74, and an impedance meter 76.

[0030] Next, the fuel cell system operation control (routine) performed in the fuel cell system 10 of this example equipped with the above-mentioned configuration is explained based on the flow chart of drawing 3 . This fuel cell system operation routine judges first whether the main switch of the fuel cell system 10 is ON, or it is OFF so that it may illustrate (step S100). In addition, since the command signal outputted from the computer for control according to the accumulation-of-electricity condition of a dc-battery etc. can be substituted for ON/OFF of this main switch, a main switch is not limited to a mechanical switch.

[0031] It may case [of starting of the system by which this fuel cell system 10 resulted in the original ON condition in response to ON of a main switch], and steady operation [which this ON condition is continuing] be under continuation when affirmative judgment is drawn at this step S100. Therefore, if the affirmative judgment in step S100 is followed, ON condition of the fuel cell system 10 judges whether the value of the flag (ON condition continuation flag FON) which shows the purport already continued for a predetermined period is 1 (step S105). In

addition, this ON condition continuation flag FON is made into initial value 0 by the initial processing before activation of this first routine, and let it be a value 0 or a value 1 by processing of this below-mentioned routine.
[0032] Here, if it is-condition continuation flag FON!=1, since it is at the system starting time to which the fuel cell system 10 resulted in the original ON condition in response to ON of a main switch, it shifts to the system starting transition stage processing (step S110) which consists of two or more processings described below. And if the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated.
[0033] By system starting transition stage processing of this step S110, as shown in drawing 4 , the interior temperature TTANK of a tank of the buffer tank 18 and the temperature TPEFC near the electrolyte membrane of PEFC12 are inputted from the Tanggu temperature sensor 53 and the cell side temperature sensor 72 (step S112), and both temperature is measured after that (step S114). That is, it judges whether the interior temperature TTANK of a tank is temperature higher than the temperature TPEFC near the electrolyte membrane.
[0034] Here, if affirmative judgment is carried out, control-objectives temperature of the internal temperature of the buffer tank 18 will be made into the temperature TPEFC near the electrolyte membrane of PEFC12 inputted at step S112, and drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 will be carried out at a flow rate increase side according to the difference of the temperature TPEFC near the electrolyte membrane, and the interior temperature TTANK of a tank (step S116). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to a temperature gradient, the interior temperature TTANK of a tank will descend. In addition, if step S116 is followed, the below-mentioned step S122 is performed.
[0035] On the other hand, when negative judgment is carried out at step S114, it judges whether the difference of TPEFC and TTANK is below the predetermined value alpha (step S118). That is, if negative judgment is carried out at step S114, it will be TTANK<=TPEFC, but if it explains to a detail more, it will judge whether the temperature gradient is proper or the interior temperature TTANK of a tank is not too low compared with the temperature TPEFC near the electrolyte membrane. If affirmative judgment is carried out at this step S118, the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, and it will shift to the below-mentioned step S122 noting that it does not have to carry out modification control of the interior temperature TTANK of a tank, since that temperature gradient is proper.
[0036] On the other hand, if negative judgment is carried out at step S118, although the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, TTANK will be too low compared with TPEFC. Therefore, drive control of the positive crankcase ventilation valve 65 of

the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side in order to carry out the temperature up of the interior temperature TTANK of a tank so that the temperature TPEFC near the electrolyte membrane may be approached (step S120). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become a decrease of a flow rate. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to a temperature gradient, the interior temperature TTANK of a tank will rise.

[0037] And if step S116,118 and step S120 are followed, based on the elapsed time after a main switch is set to ON etc., it judges whether the fuel cell system 10 is in a system starting transition stage, or it is during continuation of steady operation (step S122). Here, without performing new processing, it escapes from a "return" and each above-mentioned processing is repeated noting that it will still be a system starting transition stage, if negative judgment is carried out.

[0038] If affirmative judgment is carried out at step S122, since the fuel cell system 10 will escape from a system starting transition stage and will be during continuation of steady operation on the other hand, a value 1 is set to ON condition continuation flag FON (step S124). Thus, if FON=1, since affirmative judgment will be carried out at step S105 of this subsequent routine (refer to drawing 3), it will continue, by the time a value 1 is set to FON at this step S124, and system starting transition stage processing which consists of the above-mentioned processing to step S112-124 is performed repeatedly.

[0039] While the fuel cell system 10 is in a system starting transition stage, the temperature up of the temperature TPEFC near the electrolyte membrane is carried out with operation of PEFC12. Therefore, by repeating the system starting transition stage processing which consists of step S112-124 in the meantime, temperature up control of the buffer tank 18 is carried out from the original temperature so that the interior temperature TTANK of a tank may turn into temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, when the fuel cell system 10 is in a system starting transition stage, the hydrogen gas (before or after about 260 degrees C) which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which rose collectively to the rise of the temperature TPEFC near the electrolyte membrane while considering as the interior temperature TTANK of a tank which is temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12 through heat exchange with a cooling medium. Therefore, in the buffer tank 18, the steam in hydrogen gas is made into the saturation state in the temperature below TPEFC, and a superfluous steam is solidified and serves as waterdrop within the buffer tank 18. Moreover, the water vapor content in the hydrogen gas supplied to PEFC12 will increase to the rise of the temperature TPEFC near the electrolyte membrane collectively.

[0040] Therefore, from the gas discharge port 52 of the buffer tank 18, the

hydrogen gas intermingled by the saturation state is supplied to PEFC12 in a steam at temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, while moisture is not supplied to PEFC12 as waterdrop, inside a cell, a steam condenses and does not waterdrop-ize in the system starting transition stage of the fuel cell system 10. And it can combine with the temperature up of PEFC12, and the interior temperature TTANK of a tank in the buffer tank 18 can be raised.
[0041] Thus, in step S124 of system starting transition stage processing if FON=1, even if it is at the time of termination of system starting transition stage processing, by this next routine, affirmative judgment will be conjointly carried out to it being System ON at step S105 following the affirmative judgment of step S100. And it can be said that the fuel cell system 10 is in the condition under continuation of steady operation which ON condition is continuing in response to this affirmative judgment. Therefore, if it shifts to processing (step S130) at the time of system steady operation which consists of two or more processings described below in this case and the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated.
[0042] At the time of system steady operation of this step S130, by processing, as shown in drawing 5 , the output voltage V and the impedance Z of PEFC12 are first inputted from a voltmeter 74 and an impedance meter 76 (step S132).
[0043] If the solid-state polyelectrolyte film of PEFC12 is in a moderate damp or wet condition, since good electrical conductivity (ion conductivity) will be demonstrated, if the water content of the solid-state polyelectrolyte film becomes excessive, the output of PEFC12 will decline. Moreover, even if the electrode surface joined to this electrolyte membrane is blockaded with waterdrop, since transparency of the hydrogen gas to the film is checked, the output of PEFC12 declines too. That is, in the case of these both, it is the case where the damp or wet condition inside a cell is the excess of moisture, and if it results in the condition of this excess of moisture, the output voltage V of PEFC12 will decline. And if it becomes the excess of moisture in this way, it is known that the impedance Z of PEFC12 will fall. If the damp or wet condition inside a cell becomes insufficient [moisture] on the other hand and the water content of the solid-state polyelectrolyte film falls, while the output voltage V of PEFC12 declines, it is known that an impedance Z will rise.
[0044] Therefore, from the output voltage V of PEFC12 inputted at step S132, and an impedance Z, at step S134 following step S132, the damp or wet condition of the PEFC12 interior is proper, or it judges whether they are the excess of moisture (getting wet too much), or the lack of moisture (getting dry too much). At this step S134, fixed maintenance of the flow rate of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out noting that modification of the interior temperature TTANK of a tank in the buffer tank 18 is unnecessary in order for PEFC12 to continue proper operation if it judges that the damp or wet condition inside a cell is proper (step S136). Therefore, it is maintained by the temperature when judging that the interior temperature TTANK of a tank has a damp or wet condition inside a cell in a proper condition. For this reason, in the buffer tank 18, a constant rate solidifies and

waterdrop-izes the steam in the flowing hydrogen gas, and the water vapor content intermingled in hydrogen gas turns into a quantum. After that, it escapes from a "return" and the above-mentioned processing is repeated.
[0045] On the other hand, when it is judged that it is the excess of moisture which the damp or wet condition of the PEFC12 interior described above from output voltage V and an impedance Z at step S134, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate increase side (step S138). Under the present circumstances, the control signal which contrasts the output voltage V inputted into the positive crankcase ventilation valve 65 at output voltage V and an impedance Z, and step S132 in case the damp or wet condition inside a cell is in a proper condition, and an impedance Z, and is acquired is outputted, and drive control of the positive crankcase ventilation valve 65 is carried out so that extent of the excess of moisture is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to extent of the excess of moisture, the interior temperature TTANK of a tank will descend. Consequently, in the buffer tank 18, many amounts solidify and waterdrop-ize the steam in the flowing hydrogen gas, and since the water vapor content intermingled in hydrogen gas decreases, the water vapor content in hydrogen gas becomes less than before. And after step S136, it escapes from a "return" and the above-mentioned processing is repeated.
[0046] Thus, if it is made in charge of the interior temperature TTANK of a tank descending, increase control of the cooling-medium flow rate is carried out so that the temperature change of the interior temperature TTANK of a tank accompanying the increase of a flow rate of a cooling medium may become about -10 degrees C of maxes to the temperature TPEFC near the electrolyte membrane.

[0047] Moreover, when it is judged that the moisture which the damp or wet condition of the PEFC12 interior described above from output voltage V and an impedance Z at step S134 is insufficient, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side (step S140). Under the present circumstances, the control signal which contrasts the output voltage V inputted into the positive crankcase ventilation valve 65 at output voltage V and an impedance Z, and step S152 in case the damp or wet condition inside a cell is in a proper condition, and an impedance Z, and is acquired is outputted, and drive control of the positive crankcase ventilation valve 65 is carried out at a flow rate reduction side, so that extent with insufficient moisture is large. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to extent with insufficient moisture, the interior temperature TTANK of a tank will rise. Consequently, in the buffer tank 18, the steam in the flowing hydrogen gas carries out little deer coagulation, and does not waterdrop-ize, but the water vapor content intermingled in hydrogen gas seldom decreases. That is, the water vapor content in hydrogen gas increases more than before. And after step S140, it escapes from a "return" and the above-mentioned

processing is repeated.
[0048] Thus, if it is made in charge of the interior temperature TTANK of a tank rising, reduction control of the cooling-medium flow rate is carried out so that the temperature change of the interior temperature TTANK of a tank accompanying the increase of a flow rate of a cooling medium may become about +5 degrees C of maxes to the temperature TPEFC near the electrolyte membrane.
[0049] Therefore, since processing is repeated at the time of steady operation which consists of step S132-140 when PEFC12 is in steady operation, according to the damp or wet condition inside a cell, temperature control of the interior temperature TTANK of a tank of the buffer tank 18 is carried out. For this reason, when PEFC12 is in a steady operation condition, since temperature control of the hydrogen gas (before or after about 260 degrees C) which flowed into the buffer tank 18 is carried out through heat exchange with the cooling medium in the buffer tank 18, that amount of mixture is adjusted according to the damp or wet condition inside a cell through coagulation [in / in the steam in hydrogen gas / the buffer tank 18].
[0050] Therefore, from the gas discharge port 52 of the buffer tank 18, if the damp or wet condition inside a cell is the excess of moisture, hydrogen gas with few amounts of steam mixture than before will be supplied to PEFC12, and the excess of moisture will be canceled. Moreover, if moisture is insufficient, hydrogen gas with more amounts of steam mixture than before will be supplied to PEFC12, and the lack of moisture will be canceled. And if the excess of moisture or the lack of moisture is canceled, the intermingled hydrogen gas will continue the steam of a constant rate, and PEFC12 will be supplied.
[0051] And since accommodation of such an amount of steam mixture is performed through removal of the steam which passed through the coagulation and waterdrop-ization of the steam in hydrogen gas in the buffer tank 18, in the hydrogen gas supplied to PEFC12, moisture is intermingled as a steam, and moisture is not supplied to PEFC12 with hydrogen gas as waterdrop.
[0052] When the fuel cell system 10 is in ON condition of a system, although drive control of PEFC12 contained in the system concerned, the methanol reformer 20, and the buffer tank 18 is carried out as described above, the fuel cell system 10 results [from ON condition of a system] in an OFF condition in response to ON of OFF of a main switch, an emergency stop switch, etc. Then, as shown in drawing 3 , at step S100 of this routine, negative judgment is carried out and it shifts to the following step S145.
[0053] When the fuel cell system 10 is in an OFF condition, even if the OFF condition of the case where it changes to an OFF condition from ON condition which the fuel cell system 10 described above, and a system may be continuing and it is the case where they are these both, negative judgment is drawn at step S100. Then, at step S145 following the negative judgment of step S100, it judges again whether the value of ON condition continuation flag FON is 1 that it should judge whether it is in which OFF condition. In addition, also when each [others and] device, for example, PEFC12 and the methanol reformer 20, when a system is in an OFF condition and all the devices that constitute a system serve as OFF, and buffer tank 18 grade are in an OFF condition, it corresponds.

[0054] And if negative judgment (FON=0) is carried out at this step S145, since this ON condition continuation flag FON will not be made into a value 1 only in the system starting transition stage processing after ON of a system, it is the case where it is continuing from the beginning with FON=0 (i.e., the OFF condition of the fuel cell system 10). Therefore, when negative judgment is carried out at step S145, it escapes from a "return" and the above-mentioned processing is repeated.

[0055] However, since it is the case where the condition of the fuel cell system 10 changes to an OFF condition from ON condition when affirmative judgment is carried out at step S145 (FON=1), it shifts to the system stop transition stage processing (step S150) which consists of two or more processings described below. And if the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated. While this system stop transition stage processing is in OFF of a main switch in this system stop transition stage for the purpose of stopping the fuel cell system 10 which was under operation till then in the good condition in consideration of the time of that reboot, lowering gradually temperature TPEFC near the electrolyte membrane of PEFC12 in OFF of a main switch (descent) is also taken into consideration.

[0056] If it explains in more detail, each configuration equipment of PEFC12, the methanol reformer 20, and the fuel cell system 10 of buffer tank 18 grade will not be altogether set to OFF uniformly in OFF of a main switch. And while preventing that the residue gas intermingled in the steam flows into PEFC12 from the methanol reformer 20 interlocked and stopped by not setting each configuration equipment to OFF uniformly at OFF of the switch concerned, and a steam condenses within PEFC12 In order to aim at removal of the excessive steam in the residue gas, while after OFF of a main switch is for a while, it controls to combine the interior temperature TTANK of a tank of the buffer tank 18 with the fall of the temperature TPEFC near the electrolyte membrane of PEFC12, and to reduce it.

[0057] That is, to be shown in drawing 6 , the interior temperature TTANK of a tank is similarly followed even with step S112-120 in system starting transition stage processing at descent of the temperature TPEFC near the electrolyte membrane, and it controls by system stop transition stage processing of this step S150. First, the interior temperature TTANK of a tank and the temperature TPEFC near the electrolyte membrane are inputted (step S152), both temperature is measured after that (step S154), and it judges whether the interior temperature TTANK of a tank is temperature higher than the temperature TPEFC near the electrolyte membrane.

[0058] Here, if affirmative judgment is carried out, control-objectives temperature of the internal temperature of the buffer tank 18 will be made into the temperature TPEFC near the electrolyte membrane of PEFC12 inputted at step S152, and drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 will be carried out at a flow rate increase side according to the difference of the temperature TPEFC near the electrolyte membrane, and the interior temperature TTANK of a tank (step S156). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive

control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to a temperature gradient, the interior temperature TTANK of a tank will descend. In addition, if step S156 is followed, the below-mentioned step S162 is performed.
[0059] On the other hand, when negative judgment is carried out at step S154, it judges whether the difference of TPEFC and TTANK is below the predetermined value alpha (step S158). That is, if negative judgment is carried out at step S154, it will be TTANK<=TPEFC, but if it explains to a detail more, it will judge whether the temperature gradient is proper or the interior temperature TTANK of a tank is not too low compared with the temperature TPEFC near the electrolyte membrane. If affirmative judgment is carried out at this step S158, the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, and it will shift to the below-mentioned step S162 noting that it does not have to carry out modification control of the interior temperature TTANK of a tank, since that temperature gradient is proper.
[0060] On the other hand, if negative judgment is carried out at step S158, although the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, TTANK will be too low compared with TPEFC. Therefore, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side in order to carry out the temperature up of the interior temperature TTANK of a tank so that the temperature TPEFC near the electrolyte membrane may be approached (step S160). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become a decrease of a flow rate. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to a temperature gradient, the interior temperature TTANK of a tank will rise.
[0061] And if step S156,158 and step S160 are followed, based on the elapsed time after a main switch is set to OFF etc., it judges whether the fuel cell system 10 is in a system stop transition stage, or it is during continuation of a halt (step S162). Here, without performing new processing, it escapes from a "return" and each above-mentioned processing is repeated noting that it will still be a system stop transition stage, if negative judgment is carried out.
[0062] If affirmative judgment is carried out at step S162, since the fuel cell system 10 will halt be under continuation from having escaped from the system stop transition stage and having resulted during continuation of a halt, or the beginning on the other hand, a value 0 is set to ON condition continuation flag FON (step S164). Thus, if FON=0, since negative judgment will be carried out at step S105 of this subsequent routine (refer to drawing 3), it will continue, by the time a value 0 is set to FON at this step S164, and system stop transition stage processing which consists of the above-mentioned processing to step S152-164 is

performed repeatedly.
[0063] Therefore, since the system stop transition stage processing which consists of step S152-164 is repeated and the temperature TPEFC near the electrolyte membrane falls gradually in the meantime while the fuel cell system 10 is in a system stop transition stage, temperature fall control of the buffer tank 18 is carried out from the temperature under continuation of operation so that the interior temperature TTANK of a tank may turn into temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, when a system is made into an OFF condition in response to OFF of a main switch etc., the residue gas which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which is temperature lower than the temperature TPEFC near the electrolyte membrane of PEFC12 through heat exchange with a cooling medium. And the temperature TPEFC near the electrolyte membrane descends gradually in this case. Therefore, the residue gas which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which descended collectively to descent of the temperature TPEFC near the electrolyte membrane. Consequently, in the buffer tank 18, the steam in residue gas is made into the saturation state in temperature lower than TPEFC, and a superfluous steam is solidified, serves as waterdrop within the buffer tank 18, and is removed out of the path of the hydrogen gas supply duct 16. Moreover, to descent of the temperature TPEFC near the electrolyte membrane, the water vapor content in the residue gas supplied to PEFC12 will be combined, and will decrease.
[0064] Therefore, from the gas discharge port 52 of the buffer tank 18, the residue gas intermingled by the saturation state is supplied to PEFC12 in a steam at temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12 at that time. For this reason, in the case of a system stop, while moisture is not supplied as waterdrop, since it is TPEFC>TTANK, inside a cell, a steam condenses and does not waterdrop-ize. Therefore, in the case of a system stop, moisture does not remain as waterdrop inside a cell.
[0065] As explained above, in the fuel supply system of the fuel cell of this example, accommodation of the amount of steam mixture in the hydrogen gas which supplies moisture as a steam is performed to PEFC12 through removal of the steam which passed through accommodation of the interior temperature TTANK of a tank of the buffer tank 18. Consequently, according to the fuel supply system of the fuel cell of this example, accommodation of the amount of steam mixture in hydrogen gas can be ensured, and stabilization of the output of a fuel cell can be attained.
[0066] Moreover, in the fuel supply system of the fuel cell of this example, in the case of a system stop, moisture is not supplied to PEFC12 as waterdrop, but the coagulation of the steam in the gas in PEFC12 is avoided. For this reason, according to the fuel supply system of the fuel cell of this example, degradation of the catalyst which in the case of the system stop moisture did not remain as waterdrop inside the cell and was applied at the interface of the solid-state polyelectrolyte film / electrode zygote of PEFC12, the corrosion of the gas piping

in PEFC12, etc. are certainly avoidable.
[0067] Moreover, even if it is in the case of a system stop, moisture is supplied as a steam. Therefore, according to the fuel supply system of the fuel cell of this example, the so-called dry rise of the unprepared solid-state polyelectrolyte film can be avoided, and the starting characteristic at the time of a reboot can be raised.
[0068] Furthermore, in the fuel supply system of the fuel cell of this example, moisture is not supplied to PEFC12 as waterdrop in the starting transition stage of a system, but, moreover, the coagulation of the steam in the hydrogen gas in PEFC12 is avoided. For this reason, since according to the fuel supply system of the fuel cell of this example the electrode surface joined to the solid-state polyelectrolyte film of PEFC12 is not blockaded with waterdrop and transparency of the hydrogen gas to the film is not checked, while being able to raise the starting characteristic, proper output voltage can be obtained within an early stage from the early stages of starting.
[0069] Moreover, it is a saturation state about the steam in hydrogen gas, and the rise of the temperature TPEFC near the electrolyte membrane is made to increase the amount to the starting transition stage of a system collectively. Therefore, according to the fuel supply system of the fuel cell of this example, PEFC12 can be more quickly made steady operation through rationalization of the damp or wet condition inside the cell over between the rises of the temperature TPEFC near the electrolyte membrane.
[0070] In addition, when PEFC12 is in steady operation, even if it is, moisture is not supplied to PEFC12 as waterdrop, but the hydration to the solid-state polyelectrolyte film of PEFC12 is provided with the fuel supply system of the fuel cell of this example with the steam of a saturation state. For this reason, since according to the fuel supply system of the fuel cell of this example the electrode surface joined to the solid-state polyelectrolyte film of PEFC12 is not blockaded with waterdrop and transparency of the hydrogen gas to the film is not checked, the output stabilized through a smooth advance of the electrode reaction at the time of steady operation can be obtained.
[0071] Moreover, in the fuel supply system of the fuel cell of this example, when PEFC12 is in steady operation, the amount of mixture of the steam in hydrogen gas is adjusted according to the damp or wet condition inside a cell. For this reason, according to the fuel supply system of the fuel cell of this example, the interior of a cell can obtain the output canceled and stabilized [lack / of moisture / the excess of moisture of a through lever, or] in adjustment of the amount of steam mixture in hydrogen gas, even if the output of PEFC12 falls to the excess of moisture, or the lack of moisture very much.
[0072] Here, an evaluation trial with the fuel supply system (conventional example) with which the above-mentioned accommodation of the fuel supply system of this example and the amount of steam mixture is not performed, but the amount of steam mixture supplies the hydrogen gas of regularity (the amount of steam mixture required for a steady state) is explained. This evaluation trial was performed by measuring that output for every elapsed time from starting, when the output at the time of steady operation of PEFC12 (current value) was set to 100.

The result is shown in drawing 7 .
[0073] According to the fuel supply system of this example, the output rose smoothly from the time of starting, and when 15 minutes passed, about 90% of output at the time of a stationary was able to be obtained so that clearly from this drawing 7 . And about 100% of output was able to be continued and obtained after 30-minute progress. However, in the conventional example, although the output started rapidly in early stages of starting, the output declined gradually after 10-minute progress. And the output at the 10-minute progress time was only about 67% at the time of a stationary. Therefore, according to the fuel supply system of this example, it became clear that the stable output could be obtained. In addition, the situation of the output observed with the fuel supply system of the conventional example can be explained as follows.
[0074] In the conventional example, since the amount of steam mixture is not adjusted, although the temperature is low to a fuel cell, a lot of steams are supplied to it. For this reason, cell resistance falls temporarily and an output is improved rapidly. However, after that, it solidifies and waterdrop-izes inside a fuel cell, and an electrode is blockaded or a superfluous steam causes the rise of cell resistance. For this reason, an output declines gradually, without going up to the output at the time of a stationary.
[0075] Moreover, according to the fuel supply system of the fuel cell of this example, there are the following advantages. That is, the water which the steam waterdrop-ized is returned to a water tank 30 through the water cycle duct 60 with the pump 58 for circulation by the buffer tank 18, and it is made to circulate in the fuel supply system of the fuel cell of this example as water supplied to the methanol reformer 20. For this reason, according to the fuel supply system of the fuel cell of this example, the use effectiveness of water can be raised.
[0076] Next, other examples are explained. First, the fuel supply system of the 2nd example is explained. That configuration is different at the point made into the oxygen content gas (air) to which the cooling medium of the buffer tank 18 in the fuel cell system 10 which described above the fuel supply system of this 2nd example is supplied by PEFC12 through the oxygen gas supply line 14. That is, as shown in drawing 8 , the feeding pump 80 of air is formed in the oxygen gas supply line 14 which supplies air to PEFC12 from that upstream, and let this oxygen gas supply line 14 be the branched pipes 14a and 14b which join on the lower stream of a river of the buffer tank 18 on the lower stream of a river of the pump concerned. The positive crankcase ventilation valves 81 and 82 which adjust the flow rate which passes through the duct concerned are formed in each branched pipes 14a and 14b. In addition, as a feeding pump 80, the atmospheric-air pressurization feeder by the compressor can be illustrated. Moreover, out of the feeding pump 80, the gas transfer unit which used for example, the high-pressure air chemical cylinder and the liquid air tank can also be used.
[0077] It connects with the external piping 63 (refer to drawing 2) of the buffer tank 18, and while the air which passes this branched pipe 14b acts as the connoisseur of the cooling-medium passage 62 of the buffer tank 18, heat exchange with hydrogen gas is presented with branched pipe 14b of the side in which the positive crankcase ventilation valve 82 was formed. Moreover, the

humidifier 83 which humidifies the air which passes through a duct in this oxygen gas supply line 14 is formed in the juncture lower stream of a river of each branched pipe. in addition -- if this humidifier 83 can humidify the air which passes through a duct -- **** -- a configuration [like] may be used, and although it lets the humidifier of the method which atomizes water besides the humidifier by the bubbling method in a direct gas air current, and gas-like water (steam) pass, liquid-like water may adopt which humidifiers, such as a humidifier of the method humidified using the porous membrane which it does not let pass. Thus, when air temperature falls by humidifying with a humidifier 83, the air which carried out the temperature up to predetermined temperature can be supplied to PEFC12 by using a heating means together with a humidifier.

[0078] With the fuel supply system of the 2nd example of the above-mentioned configuration, the flow rate of the air which passes through the cooling-medium passage 62 of the buffer tank 18 can be adjusted by controlling the flow rate by carrying out drive control of the positive crankcase ventilation valves 81 and 82 of each branched pipes 14a and 14b with the control signal from an electronic control 70, for example. For this reason, according to the fuel supply system of the 2nd example, in addition to stabilization of the fuel cell output by accommodation of the amount of steam mixture in the hydrogen gas through accommodation of the interior temperature of a tank of the buffer tank 18, the air which carried out the temperature up by the buffer tank 18 can be supplied to PEFC12. Therefore, the output which made electrode reaction further carried out smoothly, and was stabilized can be obtained through temperature up accommodation of air temperature. Moreover, the special equipment for carrying out the temperature up of the air supplied to PEFC12 is not needed, but simplification of a configuration can be attained.

[0079] Next, the fuel supply system of the 3rd example is explained. That configuration is different at the point which used as the cooling water of PEFC12 the cooling medium of the buffer tank 18 in the fuel cell system 10 which described above the fuel supply system of this 3rd example. That is, as shown in drawing 9 , the cooling water pump 85 which adjusts the cooling water flow rate of the cooling-water-flow duct 84 according to the temperature TPEFC near the electrolyte membrane of PEFC12 which the cell side temperature sensor 72 (refer to drawing 1) detected, and the radiator 86 which cools the cooling water of the duct concerned to predetermined temperature through heat dissipation (maintenance) are formed in the cooling-water-flow duct 84 which carries out circulation supply of the cooling water in the cooling water passage which PEFC12 does not illustrate. Moreover, the tank cooling-water-flow duct 87 connected to the external piping 63 (refer to drawing 2) of the buffer tank 18 is established in the cooling-water-flow duct 84 so that it may branch from the cooling-water-flow duct 84 on the lower stream of a river of a cooling water pump 85 and the cooling-water-flow duct 84 may be joined in the upstream of a radiator 86. And the positive crankcase ventilation valve 88 which adjusts the flow rate which passes through the duct concerned is formed in this tank cooling-water-flow duct 87.

[0080] Therefore, while the fuel cell cooling water which passes through the tank cooling-water-flow duct 87 acts as the connoisseur of the cooling-medium

passage 62 of the buffer tank 18, heat exchange with hydrogen gas is presented. For this reason, with the fuel supply system of the 3rd example, the flow rate of the cooling water which passes through the cooling-medium passage 62 of the buffer tank 18 can be adjusted by carrying out drive control of the positive crankcase ventilation valve 88 of the tank cooling-water-flow duct 87 with the control signal from an electronic control 70. Consequently, according to the fuel supply system of the 3rd example, like the 1st example mentioned already, the amount of steam mixture in hydrogen gas can be adjusted through accommodation of the interior temperature of a tank of the buffer tank 18, and stabilization of a fuel cell output can be attained. Moreover, the special equipment only for supplying the heat exchange medium in the buffer tank 18 is not needed, but simplification of a configuration can be attained.
[0081] Next, the fuel supply system of the 4th example is explained. That configuration is different at the point using the air dryer from which the fuel supply system of this 4th example contains water absorbing polymer resin, a porous body particle, etc., adsorbs the steam in gas at these instead of the buffer tank 18 which waterdrop[coagulation and]-izes the steam in hydrogen gas by heat exchange, and adjusts the amount of steam mixture in hydrogen gas, and the steam in hydrogen gas is removed. That is, as shown in drawing 10 , let the hydrogen gas supply ducts 16 which supply hydrogen gas to PEFC12 be the branched pipes 16a and 16b which branch on the lower stream of a river of the methanol reformer 20, and join between the methanol reformer 20 and PEFC12 in PEFC12 this side. The positive crankcase ventilation valves 89 and 90 which adjust the flow rate which passes through the duct concerned are formed in each branched pipes 16a and 16b. And the air dryer 91 from which the steam in gas is adsorbed on the lower stream of a river of a positive crankcase ventilation valve 90, and the steam in hydrogen gas is removed is formed in branched pipe 16b. This air dryer 91 has the capacity which dehumidifies a fixed steam per [which passes the equipment concerned] unit flow rate of hydrogen gas with the amount and property of the water absorbing polymer resin to build in. For this reason, the amount of steam removal can be adjusted by changing the flow rate of the hydrogen gas which passes an air dryer 91.
[0082] In the fuel supply system of the 4th example of the above-mentioned configuration, the amount of steam mixture in the hydrogen gas which each branched pipe joins and results in PEFC12 can be adjusted through the steam removal by the air dryer 91 by controlling the flow rate by carrying out drive control of the positive crankcase ventilation valves 89 and 90 of each branched pipes 16a and 16b with the control signal from an electronic control 70, for example. For this reason, according to the fuel supply system of the 4th example, stabilization of a fuel cell output can be attained. In addition, the air dryer which has different dehumidification capacity from the air dryer 91 of branched pipe 16b can be formed in the lower stream of a river of a positive crankcase ventilation valve 89 also at branched pipe 16a, and it can also constitute so that drive control of the positive crankcase ventilation valves 89 and 90 of each branched pipes 16a and 16b may be carried out with the control signal from an electronic control 70.
[0083] Although one example of this invention was explained above, as for this

invention, it is needless to say that it can carry out in the mode which becomes various in the range which is not limited to such an example at all and does not deviate from the summary of this invention.
[0084] for example, system stop transition stage processing -- setting -- the interior temperature TTANK of a tank -- below the temperature TPEFC near the electrolyte membrane -- the temperature gradient -- being proper (alpha) -- temperature fall control was carried out so that it might become, but (step S158,160) it can also constitute so that it may become the temperature below the temperature TPEFC near the electrolyte membrane and temperature fall control of the interior temperature TTANK of a tank may be carried out. That is, what is necessary is to skip step S158 in system stop transition stage processing, and just to shift to step S160, when negative judgment is carried out at step S154.
[0085] In addition, although the amount of steam mixture in hydrogen gas was adjusted by removing out of a hydrogen gas pipe way, in order to attain stabilization of the output of a fuel cell, steam removal and steam mixing can be used together and it can also constitute from an above-mentioned example as follows.
[0086] Namely, are the fuel supply system which supplies this hydrogen gas, and steam reforming of the hydrocarbon compound is carried out to the fuel cell which makes hydrogen gas fuel gas. A reforming means to generate hydrogen gas in the state of mixture of a steam, and a supply means to supply the this generated hydrogen gas to said fuel cell with said steam, An operational status detection means to detect the operational status of said fuel cell, and a damp or wet condition judging means to judge the damp or wet condition of said fuel cell based on the this detected operational status, It has the amount increase-and-decrease of steam mixture means of accommodation which carries out increase and decrease of the amount of steam mixture in the hydrogen gas supplied to said fuel cell of accommodation according to said judged damp or wet condition.
[0087] In this case, the amount increase-and-decrease of steam mixture means of accommodation which carries out increase and decrease of the amount of steam mixture of accommodation is realized by using together the steam stripper of the buffer tank 18 in each above-mentioned example, or air dryer 91 grade, and steam mixing equipments, such as humidification equipment.
[0088] With the fuel supply system of this fuel cell, in adjusting the amount of steam mixture in the hydrogen gas supplied to a fuel cell, a steam is mixed into hydrogen gas or increase and decrease of the amount of steam mixture of accommodation are carried out by removing. And this increase and decrease of adjustment are performed according to the damp or wet condition of the fuel cell judged based on the operational status of a fuel cell. For this reason, if the humidity of a fuel cell is excessive, the amount of steam mixture in the hydrogen gas supplied can be adjusted fewer by removal of a steam, and the excess of humid can be avoided. On the other hand, if the humidity of a fuel cell is insufficient, more amounts of steam mixture in the hydrogen gas supplied can be adjusted by addition of a steam, and the lack of humid can be avoided. Consequently, the output which let Lycium chinense pass at the suitable damp or wet condition, and was stabilized in the fuel cell can always be obtained.

[0089]
[Effect of the Invention] As explained in full detail above, in the fuel supply system of claim 1 thru/or a fuel cell according to claim 4, accommodation of the amount of steam mixture in the hydrogen gas which supplies moisture as a steam is ensured to a fuel cell through removal of a steam. Consequently, according to the fuel supply system of the fuel cell of this invention, Lycium chinense can do a fuel cell in an always suitable damp or wet condition, and stabilization of the output of a fuel cell can be attained. Moreover, since a humidifier etc. is not needed separately, simplification of the configuration can also be attained.
[0090] And moisture is not supplied to a fuel cell as waterdrop, but the hydration to a fuel cell is provided with the fuel supply system of claim 1 thru/or a fuel cell according to claim 4 with the steam of a saturation state. Consequently, since according to the fuel supply system of claim 1 thru/or a fuel cell according to claim 4 the electrode in a fuel cell is not blockaded with waterdrop and transparency of the hydrogen gas to an electrolyte membrane is not checked, the output stabilized through a smooth advance of electrode reaction can be obtained.
[0091] In the fuel supply system of a fuel cell according to claim 2, the amount of mixture of the steam in the hydrogen gas supplied to a fuel cell is adjusted according to the damp or wet condition of a fuel cell. For this reason, according to the fuel supply system of a fuel cell according to claim 2, the interior of a cell can obtain the output canceled and stabilized [lack / of moisture / the excess of moisture of a through lever, or] in adjustment of the amount of steam mixture in hydrogen gas, even if an output falls to the excess of moisture, or the lack of moisture very much.
[0092] The internal temperature of a buffer container is controlled by the fuel supply system of a fuel cell according to claim 4 through heat exchange with the oxygen content gas supplied to a fuel cell, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted. For this reason, according to the fuel supply system of a fuel cell according to claim 4, since the temperature of oxygen content gas can also be adjusted in addition to accommodation of the amount of steam mixture in hydrogen gas, stabilization of an output can be attained through much more carrying out smoothly of electrode reaction. Moreover, the special equipment for carrying out the temperature up of the oxygen content gas supplied to a fuel cell is not needed, but simplification of a configuration can be attained.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Industrial Application] This invention relates to the fuel supply system which supplies this hydrogen gas to the fuel cell which makes hydrogen gas fuel gas.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] Generally, the fuel cell which makes hydrogen gas fuel gas has the electrolyte and electrode which penetrate a hydrogen ion in the state of the hydration of H+ (xH2O), makes the catalyst bed for promoting electrode reaction intervene, and is pinched and equipped with this electrolyte with an electrode. Although such a fuel cell has various things (for example, a polymer electrolyte fuel cell, a phosphoric acid mold fuel cell, etc.) according to the class of electrolyte to be used, the electrode reaction which a difference does not have in the electrode reaction which advances in a positive-negative electrode, and advances on each pole is as follows.
Cathode (hydrogen pole): 2H2 ->4H++4e- --** anode plate (oxygen pole): 4H++4e- +O2 ->2H2O -- ** [0003] And if the hydrogen gas which is fuel gas is supplied to cathode, in cathode, the reaction formula of ** will advance and a hydrogen ion will generate. If this generated hydrogen ion penetrates an electrolyte (if it is a polymer electrolyte fuel cell solid-state polyelectrolyte film) in the state of the hydration of H+ (xH2O) (diffusion), and reaches an anode plate and oxygen content gas, for example, air, is supplied to this anode plate, the reaction formula of ** will advance in an anode plate. A fuel cell will present electromotive force because the electrode reaction of this ** and ** advances on each pole.
[0004] The electrolyte of a fuel cell will be in the condition that moisture runs short on the convenience which penetrates an electrolyte to an anode plate side (diffusion), and by the cathode side from a cathode side in the state of the hydration which the hydrogen ion described above. Moreover, although the solid-state polyelectrolyte film used for a polymer electrolyte fuel cell will demonstrate good electrical conductivity (ion conductivity) if it is in a moderate damp or wet condition, if water content falls, ion conductivity will get worse, and it stops functioning as an electrolyte, and will stop electrode reaction depending on the case. Moreover, even if water content is too high, there is an inclination for ion conductivity to get worse. For this reason, while supplying the hydrogen gas as fuel gas to cathode, it is necessary to always supply a suitable quantity of water. Therefore, the hydrogen gas humidified with the steam is supplied to the fuel cell from the fuel supply system.
[0005] In order to supply the hydrogen gas by which steam humidification was carried out from the fuel supply system to a fuel cell, there are various approaches and the following techniques are well known as simplest approach. That is, in

carrying out steam reforming of the hydrocarbon compounds, such as a methanol, and generating hydrogen gas, since reforming ****** of a methanol and water is an equimolar reaction, it is the approach of humidifying hydrogen gas with the steam of the amount which supplies excessive water a little to a methanol, is made to cause a reforming reaction, and is equivalent to excessive water. Moreover, in JP,3-269955,A, heat exchange of the generated hydrogen gas is carried out, it is lowered, a steam is added before a fuel cell in the hydrogen gas after a temperature fall, and the technique which supplies the hydrogen gas humidified by steaming to a fuel cell is proposed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained in full detail above, in the fuel supply system of claim 1 thru/or a fuel cell according to claim 4, accommodation of the amount of steam mixture in the hydrogen gas which supplies moisture as a steam is ensured to a fuel cell through removal of a steam. Consequently, according to the fuel supply system of the fuel cell of this invention, Lycium chinense can do a fuel cell in an always suitable damp or wet condition, and stabilization of the output of a fuel cell can be attained. Moreover, since a humidifier etc. is not needed separately, simplification of the configuration can also be attained.
[0090] And moisture is not supplied to a fuel cell as waterdrop, but the hydration to a fuel cell is provided with the fuel supply system of claim 1 thru/or a fuel cell according to claim 4 with the steam of a saturation state. Consequently, since according to the fuel supply system of claim 1 thru/or a fuel cell according to claim 4 the electrode in a fuel cell is not blockaded with waterdrop and transparency of the hydrogen gas to an electrolyte membrane is not checked, the output stabilized through a smooth advance of electrode reaction can be obtained.
[0091] In the fuel supply system of a fuel cell according to claim 2, the amount of mixture of the steam in the hydrogen gas supplied to a fuel cell is adjusted according to the damp or wet condition of a fuel cell. For this reason, according to the fuel supply system of a fuel cell according to claim 2, the interior of a cell can obtain the output canceled and stabilized [lack / of moisture / the excess of moisture of a through lever, or] in adjustment of the amount of steam mixture in hydrogen gas, even if an output falls to the excess of moisture, or the lack of moisture very much.
[0092] The internal temperature of a buffer container is controlled by the fuel supply system of a fuel cell according to claim 4 through heat exchange with the oxygen content gas supplied to a fuel cell, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted. For this reason, according to the fuel supply system of a fuel cell according to claim 4, since the temperature of oxygen content gas can also be adjusted in addition to accommodation of the amount of steam mixture in hydrogen gas, stabilization of an output can be attained through much more carrying out smoothly of electrode reaction. Moreover, the special equipment for carrying out the temperature up of the oxygen content gas supplied to a fuel cell is not needed, but simplification of a configuration can be attained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in supplying excessive water a little to a methanol, making a reforming reaction cause in the state of the excess of moisture and humidifying, there are the following faults. For example, when it fixes the amount of redundant water, in order to avoid the lack of humidification of a fuel cell, it is necessary to supply with a steam the moisture maximum needed for the time of a generation of electrical energy of a fuel cell. therefore -- although it is necessary to supply the redundant water of a quantum and to make a reforming reaction cause -- changing the water vapor content in hydrogen gas depending on advance extent of a reforming reaction **** -- the generation-of-electrical-energy condition of a fuel cell -- moisture -- being excessive -- becoming -- an electrolyte membrane -- being the so-called -- getting wet -- passing -- ** -- a sake -- electrode reaction -- falling -- cell performance degradation -- inviting -- things -- it is .
[0007] Moreover, although it is also possible to adjust the water vapor content in hydrogen gas, i.e., humidification extent of a fuel cell, through the increase and decrease of accommodation of the amount of the water used for a reforming reaction, it is not realistic from the following reasons. That is, since the mol number of water decreases to a methanol in performing accommodation of the amount of feedwaters to a reduction side, the increase of the occurrence frequency of the carbon monoxide which is the intermediate product of a reforming reaction, and this carbon monoxide will be supplied to the cathode of a fuel cell. Thus, if a carbon monoxide reaches cathode, poisoning of the catalyst of a catalyst bed established in order to promote electrode reaction will be carried out with a carbon monoxide, and the function as a catalyst will fall. For this reason, a halt of electrode reaction, as a result the shutdown of a fuel cell are caused.
[0008] on the other hand, it is proposed by JP,3-269955,A -- as -- the temperature of reformed gas -- the temperature of a fuel cell, and abbreviation -- it was difficult to lower to same extent, and for both the heat exchanger for lowering temperature and the humidifier which adds water to be needed for the lowered reformed gas with the technique which adds water separately, and to attain miniaturization of a system. Moreover, when the heat exchanger was excluded simply, it originated in the temperature of the reformed gas supplied to a humidifier being an elevated temperature (about 250-300 degrees C), and there was a problem that controlling in the desired humidification condition became

difficult. For example, when the bubbler which is a common humidifier was used, since reformed gas was rapidly cooled with the water in a bubbler, the moisture which reformed gas holds was added in the bubbler, the water management of a bubbler became difficult, and also the temperature of the water in a bubbler itself was influenced with reformed gas, and there was a problem of being hard coming to control the amount of humidification.

[0009] This invention is made in order to solve the above-mentioned trouble, and it aims at attaining stabilization of the output of the fuel cell which makes hydrogen gas fuel gas.

[Translation done.]

MEANS

[Means for Solving the Problem] The means adopted with the fuel supply system of the fuel cell according to claim 1 for attaining this purpose Are the fuel supply system which supplies this hydrogen gas, and steam reforming of the hydrocarbon compound is carried out to the fuel cell which makes hydrogen gas fuel gas. A reforming means to generate hydrogen gas in the state of mixture of a steam, and a supply means to supply the this generated hydrogen gas to said fuel cell with said steam, Said steam is removed in the path of the this hydrogen gas supplied, and let it be the summary to have an amount accommodation means of steam mixture to adjust the amount of steam mixture in the hydrogen gas supplied to said fuel cell.
[0011] In this case, in the fuel supply system of a fuel cell according to claim 2, it has an operational status detection means to detect the operational status of said fuel cell, a damp or wet condition judging means to judge the damp or wet condition of said fuel cell based on the this detected operational status, and the control means that controls said amount accommodation means of steam mixture according to the this judged damp or wet condition.
[0012] Moreover, in the fuel supply system of a fuel cell according to claim 3, said amount accommodation means of steam mixture is formed in the path of said hydrogen gas, and it has the buffer container with which hydrogen gas flows with a steam, and the temperature control section which controls the internal temperature of this buffer container.
[0013] In this case, said buffer container is constituted so that heat exchange can perform the fluid path which the oxygen content gas supplied to said fuel cell passes between the interior of a container, and said temperature control section controls said oxygen content capacity which passes said fluid path by the fuel supply system of a fuel cell according to claim 4.

[Translation done.]

OPERATION

[Function] In the fuel supply system of the fuel cell according to claim 1 which has the above-mentioned configuration, first, steam reforming of the hydrocarbon compound is carried out with a reforming means, and hydrogen gas is generated in the state of mixture of a steam. Although this generated hydrogen gas is supplied to a fuel cell with a steam by the supply means, in that path, the amount of steam mixture in hydrogen gas is certainly adjusted through removal of the steam by the amount accommodation means of steam mixture. Therefore, since the moisture in the hydrogen gas supplied to a fuel cell is intermingled as a steam, without waterdrop-izing, water is not supplied to a fuel cell with hydrogen gas as waterdrop.

[0015] In the fuel supply system of a fuel cell according to claim 2, the damp or wet condition of a fuel cell is judged with a damp or wet condition judging means based on the operational status of the fuel cell which the operational status detection means detected. And since an amount accommodation means of steam mixture to adjust the amount of steam mixture in hydrogen gas is controlled by the control means according to the damp or wet condition of a fuel cell, according to the damp or wet condition of a fuel cell, the amount of steam mixture in hydrogen gas can be adjusted. Therefore, the excess of moisture is cancelable with the moisture as a steam adjusting the amount of steam mixture few, if the damp or wet condition of a fuel cell is the excess of moisture. The lack of moisture is cancelable with the moisture as a steam, adjusting many amounts of steam mixture on the other hand, if moisture is insufficient.

[0016] In the fuel supply system of a fuel cell according to claim 3, since the internal temperature of a buffer container prepared in the path of hydrogen gas is controlled by the temperature control section, the steam in the hydrogen gas which flows into a buffer container with a steam is removed within this buffer container, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted.

[0017] it is alike, the fluid path for which the oxygen content gas supplied by the fuel cell passes a buffer container is made [for which heat exchange can be performed between the interior of a buffer container / which was constituted] good, and the oxygen content capacity which passes a fluid path is controlled by the fuel supply system of a fuel cell according to claim 4 by the temperature control section. Therefore, the internal temperature of a buffer container is

controlled through heat exchange with oxygen content gas, and the amount of steam mixture in the hydrogen gas supplied to a fuel cell is adjusted. For this reason, the temperature of oxygen content gas can also be adjusted with accommodation of the amount of steam mixture in hydrogen gas.
[0018]

[Translation done.]

EXAMPLE

[Example] Next, the suitable example of the fuel supply system of the fuel cell concerning this invention is explained based on a drawing. Drawing 1 is the block diagram of the fuel cell system which applied the fuel supply system of an example.

[0019] It has the fuel cell system 10 of an example centering on a polymer electrolyte fuel cell (it is hereafter called PEFC for short) 12, and the hydrogen gas obtained by the air which is oxygen content gas carrying out steam reforming of the methanol from the hydrogen gas supply duct 16 is supplied to PEFC12 from the oxygen gas supply line 14, respectively. The buffer tank 18 which adjusts the amount of steam mixture in hydrogen gas, and the methanol reformer 20 are formed in the duct of the hydrogen gas supply duct 16. In addition, although the check valve is prepared in both the above-mentioned ducts in the proper part, since it is not directly related to the summary of this invention, it is not illustrated.

[0020] PEFC12 is pinched and equipped with the solid-state polyelectrolyte film with a positive-negative electrode, and advances electrode reaction of above ** and ** in a positive-negative electrode in response to supply with the air to an anode plate, and the hydrogen gas to cathode. And PEFC12 drives the motor in an external driver, for example, an electric vehicle, through wiring 22 and 24 with the electromotive force pass the electrode reaction concerned.
[0021] The methanol reformer 20 receives supply of a methanol from the methanol tank 26 with the feeding pump 28, and receives supply of water from a water tank 30 with the feeding pump 32. And the methanol reformer 20 advances the reforming reaction of a methanol and water at the temperature of 250-300 degrees C through a reforming catalyst, carries out steam reforming of the methanol, and generates hot (before or after about 260 degrees C) hydrogen gas in the state of mixture of a steam. This generated hydrogen gas is sent out to the buffer tank 18 of that lower stream of a river.
[0022] Thus, in supplying water to the methanol reformer 20 from a water tank 30, the water of a little excessive amount is supplied to the methanol so that it may explain below. That is, the amount of supply of the water to the methanol reformer 20 is defined so that it may remain as a steam in the hydrogen gas which steam reforming of the water supplied to the methanol reformer 20 is carried out, and it generates by the methanol reformer 20 and may increase more than the maximum

water vapor content for which the amount of survival (the amount of steam mixture) may moreover be needed at the time of the drive of PEFC12 (at the time of a generation of electrical energy) a little. If it puts in another way, even if hydrogen gas temperature descends to the temperature approximated to the operating temperature (80-100 degrees C) of about 260 degrees C to PEFC12, for example, 80 degrees C, the water of a little excessive amount is supplied to extent from which the steam in the hydrogen gas in the temperature can be in a saturation state to the methanol.

[0023] The buffer tank 18 by which hydrogen gas is sent out from the methanol reformer 20 has the temperature regulatory mechanism which adjusts the temperature inside a tank, lets the operation control of this temperature regulatory mechanism by the electronic control mentioned later pass, and controls the interior temperature of a tank. In this case, hot (before or after about 260 degrees C) hydrogen gas is sent to the buffer tank 18 from the methanol reformer 20, and, as for the hydrogen gas temperature supplied to PEFC12 from the buffer tank 18, it is desirable that it is the temperature approximated to the operating temperature (80-100 degrees C) of PEFC12. For this reason, the buffer tank 18 is equipped with the following configurations as a temperature regulatory mechanism which used cooling media, such as water and air.

[0024] As shown in drawing 2 , the buffer tank 18 plugs up the vertical edge of the metal body container section 40 with the up covering section 42 and the lower covering section 44, it makes O ring 46 intervene, binds these tight watertight with a bolt 48, and is formed. The gas installation port 50 is established in the up covering section 42, and the port concerned is connected with the methanol reformer 20. Moreover, the gas discharge port 52 is established in the up covering section 42, and the port concerned is connected with PEFC12. For this reason, the hydrogen gas which hot hydrogen gas flowed into the buffer tank 18 interior in the state of mixture of a steam from the methanol reformer 20 through the gas installation port 50, and flowed in the tank will be supplied to PEFC12 through the gas discharge port 52. Furthermore, attachment immobilization of the Tanggu temperature sensor 53 which detects the temperature of the buffer tank 18 interior is carried out at the up covering section 42. In addition, this Tanggu temperature sensor 53 is connected to the below-mentioned electronic control 70.

[0025] On the other hand, the water discharge port 56 for discharging the water 54 solidified and liquefied inside the buffer tank is established in the lower covering section 44, and it gets down, and as shown in drawing 1 , this water discharge port 56 makes the pump 58 for circulation intervene, and is connected with the water tank 30 by the water cycle duct 60. For this reason, the water 54 which piled up in the buffer tank 18 interior is returned to a water tank 30 with the pump 58 for circulation, and it circulates through it as water supplied to the methanol reformer 20. In addition, the above-mentioned hydrologic cycle is intermittently performed by the intermittent drive of the pump 58 for circulation for every predetermined time.

[0026] It is formed in the side attachment wall of the body container section 40 so that the cooling-medium passage 62 through which cooling media, such as water

and air, pass may enclose the interior of a container. Therefore, if a cooling medium flows into the cooling-medium passage 62 through the external piping 63 from the input which is not illustrated and a cooling medium passes through the passage concerned, heat exchange will break out between the cooling medium concerned and the hydrogen gas of the buffer tank 18 interior. For this reason, it is possible to control the interior temperature of a tank through the control of the temperature of a cooling medium or through put (per unit time amount flow rate) which passes through the cooling-medium passage 62, i.e., to control hydrogen gas temperature. In addition, this cooling-medium passage 62 may be formed according to an individual independently of ****** passage, and may be formed spirally.
[0027] The septum 64 of the porosity which divides the interior of a tank up and down is formed in the interior of the body container section 40, and the up space divided by this septum 64 is filled up with the metal with high thermal conductivity, or the spherical packing object 66 of a ceramic. For this reason, heat exchange of the hot hydrogen gas of the steam mixture condition which flowed through the gas installation port 50, and the cooling medium which passes through the cooling-medium passage 62 is efficiently performed through the spherical packing object 66 of the up space of the septum 64 upper part. Moreover, the body container section 40 is covered with the heat insulator 68 in the periphery, and emission of the heat from body container section 40 side attachment wall to the exterior is intercepted.

[0028] Therefore, if hot (before or after about 260 degrees C) hydrogen gas flows into the buffer tank 18 which has the above-mentioned structure in the state of mixture of a steam, in the buffer tank 18 interior, it will be cooled through heat exchange with a cooling medium, and this hot hydrogen gas will be made into the temperature of the cooling medium which passes through the cooling-medium passage 62, or the temperature specified with that through put. By cooling of this hydrogen gas, the steam in hydrogen gas will be solidified in the buffer tank 18 interior about the part exceeding the amount of saturated steam in the hydrogen gas temperature after cooling (interior temperature of a tank), and will serve as waterdrop, and a steam will exist by the saturation state in hydrogen gas. The flow rate of the cooling medium which passes through the cooling-medium passage 62 becomes settled with the control signal from an electronic control, and accommodation is made whenever [flow control, i.e., tank internal temperature,] by carrying out drive control of the positive crankcase ventilation valve 65 prepared in the external piping 63 connected to the cooling-medium passage 62 of the buffer tank 18. In addition, the solidified waterdrop passes the hole of a septum 64, falls to the lower space of septum 64 lower part, and is returned to a water tank 30 from the water discharge port 56.
[0029] The fuel cell system 10 is equipped with the cell side temperature sensor 72 which, in addition to this, detects the temperature near the joint of the electronic control 70 for controlling the interior temperature of a tank in the buffer tank 18, and the solid-state polyelectrolyte film and electrode (cathode) in PEFC12, the voltmeter 74 which detects the output voltage of PEFC12, and the impedance meter 76 which detects an impedance. This electronic control 70 is constituted as a logic operation circuit focusing on CPU, ROM, and RAM, and

performs I/O with the exterior by the input port and the output port which were mutually connected through these and a common bus. In the fuel cell system 10 of this example, an electronic control 70 carries out drive control of the positive crankcase ventilation valve 65 of the buffer tank 18 that the input of the impedance Z of the interior temperature TTANK of a tank of the buffer tank 18, the temperature TPEFC near the electrolyte membrane of PEFC12, and the output voltage V and PEFC12 of PEFC12 should be received, and the internal temperature of the buffer tank 18 should be adjusted from the Tanggu temperature sensor 53, the cell side temperature sensor 72, a voltmeter 74, and an impedance meter 76.

[0030] Next, the fuel cell system operation control (routine) performed in the fuel cell system 10 of this example equipped with the above-mentioned configuration is explained based on the flow chart of drawing 3 . This fuel cell system operation routine judges first whether the main switch of the fuel cell system 10 is ON, or it is OFF so that it may illustrate (step S100). In addition, since the command signal outputted from the computer for control according to the accumulation-of-electricity condition of a dc-battery etc. can be substituted for ON/OFF of this main switch, a main switch is not limited to a mechanical switch.

[0031] It may case [of starting of the system by which this fuel cell system 10 resulted in the original ON condition in response to ON of a main switch], and steady operation [which this ON condition is continuing] be under continuation when affirmative judgment is drawn at this step S100. Therefore, if the affirmative judgment in step S100 is followed, ON condition of the fuel cell system 10 judges whether the value of the flag (ON condition continuation flag FON) which shows the purport already continued for a predetermined period is 1 (step S105). In addition, this ON condition continuation flag FON is made into initial value 0 by the initial processing before activation of this first routine, and let it be a value 0 or a value 1 by processing of this below-mentioned routine.

[0032] Here, if it is-condition continuation flag FON!=1, since it is at the system starting time to which the fuel cell system 10 resulted in the original ON condition in response to ON of a main switch, it shifts to the system starting transition stage processing (step S110) which consists of two or more processings described below. And if the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated.

[0033] By system starting transition stage processing of this step S110, as shown in drawing 4 , the interior temperature TTANK of a tank of the buffer tank 18 and the temperature TPEFC near the electrolyte membrane of PEFC12 are inputted from the Tanggu temperature sensor 53 and the cell side temperature sensor 72 (step S112), and both temperature is measured after that (step S114). That is, it judges whether the interior temperature TTANK of a tank is temperature higher than the temperature TPEFC near the electrolyte membrane.

[0034] Here, if affirmative judgment is carried out, control-objectives temperature of the internal temperature of the buffer tank 18 will be made into the temperature TPEFC near the electrolyte membrane of PEFC12 inputted at step S112, and drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 will be carried out at a flow rate increase side according to the

difference of the temperature TPEFC near the electrolyte membrane, and the interior temperature TTANK of a tank (step S116). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to a temperature gradient, the interior temperature TTANK of a tank will descend. In addition, if step S116 is followed, the below-mentioned step S122 is performed.
[0035] On the other hand, when negative judgment is carried out at step S114, it judges whether the difference of TPEFC and TTANK is below the predetermined value alpha (step S118). That is, if negative judgment is carried out at step S114, it will be TTANK<=TPEFC, but if it explains to a detail more, it will judge whether the temperature gradient is proper or the interior temperature TTANK of a tank is not too low compared with the temperature TPEFC near the electrolyte membrane. If affirmative judgment is carried out at this step S118, the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, and it will shift to the below-mentioned step S122 noting that it does not have to carry out modification control of the interior temperature TTANK of a tank, since that temperature gradient is proper.
[0036] On the other hand, if negative judgment is carried out at step S118, although the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, TTANK will be too low compared with TPEFC. Therefore, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side in order to carry out the temperature up of the interior temperature TTANK of a tank so that the temperature TPEFC near the electrolyte membrane may be approached (step S120). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become a decrease of a flow rate. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to a temperature gradient, the interior temperature TTANK of a tank will rise.
[0037] And if step S116,118 and step S120 are followed, based on the elapsed time after a main switch is set to ON etc., it judges whether the fuel cell system 10 is in a system starting transition stage, or it is during continuation of steady operation (step S122). Here, without performing new processing, it escapes from a "return" and each above-mentioned processing is repeated noting that it will still be a system starting transition stage, if negative judgment is carried out.
[0038] If affirmative judgment is carried out at step S122, since the fuel cell system 10 will escape from a system starting transition stage and will be during continuation of steady operation on the other hand, a value 1 is set to ON condition continuation flag FON (step S124). Thus, if FON=1, since affirmative

judgment will be carried out at step S105 of this subsequent routine (refer to drawing 3), it will continue, by the time a value 1 is set to FON at this step S124, and system starting transition stage processing which consists of the above-mentioned processing to step S112-124 is performed repeatedly.
[0039] While the fuel cell system 10 is in a system starting transition stage, the temperature up of the temperature TPEFC near the electrolyte membrane is carried out with operation of PEFC12. Therefore, by repeating the system starting transition stage processing which consists of step S112-124 in the meantime, temperature up control of the buffer tank 18 is carried out from the original temperature so that the interior temperature TTANK of a tank may turn into temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, when the fuel cell system 10 is in a system starting transition stage, the hydrogen gas (before or after about 260 degrees C) which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which rose collectively to the rise of the temperature TPEFC near the electrolyte membrane while considering as the interior temperature TTANK of a tank which is temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12 through heat exchange with a cooling medium. Therefore, in the buffer tank 18, the steam in hydrogen gas is made into the saturation state in the temperature below TPEFC, and a superfluous steam is solidified and serves as waterdrop within the buffer tank 18. Moreover, the water vapor content in the hydrogen gas supplied to PEFC12 will increase to the rise of the temperature TPEFC near the electrolyte membrane collectively.
[0040] Therefore, from the gas discharge port 52 of the buffer tank 18, the hydrogen gas intermingled by the saturation state is supplied to PEFC12 in a steam at temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, while moisture is not supplied to PEFC12 as waterdrop, inside a cell, a steam condenses and does not waterdrop-ize in the system starting transition stage of the fuel cell system 10. And it can combine with the temperature up of PEFC12, and the interior temperature TTANK of a tank in the buffer tank 18 can be raised.
[0041] Thus, in step S124 of system starting transition stage processing if FON=1, even if it is at the time of termination of system starting transition stage processing, by this next routine, affirmative judgment will be conjointly carried out to it being System ON at step S105 following the affirmative judgment of step S100. And it can be said that the fuel cell system 10 is in the condition under continuation of steady operation which ON condition is continuing in response to this affirmative judgment. Therefore, if it shifts to processing (step S130) at the time of system steady operation which consists of two or more processings described below in this case and the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated.
[0042] At the time of system steady operation of this step S130, by processing, as shown in drawing 5 , the output voltage V and the impedance Z of PEFC12 are first inputted from a voltmeter 74 and an impedance meter 76 (step S132).
[0043] If the solid-state polyelectrolyte film of PEFC12 is in a moderate damp or

wet condition, since good electrical conductivity (ion conductivity) will be demonstrated, if the water content of the solid-state polyelectrolyte film becomes excessive, the output of PEFC12 will decline. Moreover, even if the electrode surface joined to this electrolyte membrane is blockaded with waterdrop, since transparency of the hydrogen gas to the film is checked, the output of PEFC12 declines too. That is, in the case of these both, it is the case where the damp or wet condition inside a cell is the excess of moisture, and if it results in the condition of this excess of moisture, the output voltage V of PEFC12 will decline. And if it becomes the excess of moisture in this way, it is known that the impedance Z of PEFC12 will fall. If the damp or wet condition inside a cell becomes insufficient [moisture] on the other hand and the water content of the solid-state polyelectrolyte film falls, while the output voltage V of PEFC12 declines, it is known that an impedance Z will rise.
[0044] Therefore, from the output voltage V of PEFC12 inputted at step S132, and an impedance Z, at step S134 following step S132, the damp or wet condition of the PEFC12 interior is proper, or it judges whether they are the excess of moisture (getting wet too much), or the lack of moisture (getting dry too much). At this step S134, fixed maintenance of the flow rate of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out noting that modification of the interior temperature TTANK of a tank in the buffer tank 18 is unnecessary in order for PEFC12 to continue proper operation if it judges that the damp or wet condition inside a cell is proper (step S136). Therefore, it is maintained by the temperature when judging that the interior temperature TTANK of a tank has a damp or wet condition inside a cell in a proper condition. For this reason, in the buffer tank 18, a constant rate solidifies and waterdrop-izes the steam in the flowing hydrogen gas, and the water vapor content intermingled in hydrogen gas turns into a quantum. After that, it escapes from a "return" and the above-mentioned processing is repeated.
[0045] On the other hand, when it is judged that it is the excess of moisture which the damp or wet condition of the PEFC12 interior described above from output voltage V and an impedance Z at step S134, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate increase side (step S138). Under the present circumstances, the control signal which contrasts the output voltage V inputted into the positive crankcase ventilation valve 65 at output voltage V and an impedance Z, and step S132 in case the damp or wet condition inside a cell is in a proper condition, and an impedance Z, and is acquired is outputted, and drive control of the positive crankcase ventilation valve 65 is carried out so that extent of the excess of moisture is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to extent of the excess of moisture, the interior temperature TTANK of a tank will descend. Consequently, in the buffer tank 18, many amounts solidify and waterdrop-ize the steam in the flowing hydrogen gas, and since the water vapor content intermingled in hydrogen gas decreases, the water vapor content in hydrogen gas becomes less than before. And after step S136, it escapes from a "return" and the above-

mentioned processing is repeated.
[0046] Thus, if it is made in charge of the interior temperature TTANK of a tank descending, increase control of the cooling-medium flow rate is carried out so that the temperature change of the interior temperature TTANK of a tank accompanying the increase of a flow rate of a cooling medium may become about -10 degrees C of maxes to the temperature TPEFC near the electrolyte membrane.

[0047] Moreover, when it is judged that the moisture which the damp or wet condition of the PEFC12 interior described above from output voltage V and an impedance Z at step S134 is insufficient, drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side (step S140). Under the present circumstances, the control signal which contrasts the output voltage V inputted into the positive crankcase ventilation valve 65 at output voltage V and an impedance Z, and step S152 in case the damp or wet condition inside a cell is in a proper condition, and an impedance Z, and is acquired is outputted, and drive control of the positive crankcase ventilation valve 65 is carried out at a flow rate reduction side, so that extent with insufficient moisture is large. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to extent with insufficient moisture, the interior temperature TTANK of a tank will rise. Consequently, in the buffer tank 18, the steam in the flowing hydrogen gas carries out little deer coagulation, and does not waterdrop-ize, but the water vapor content intermingled in hydrogen gas seldom decreases. That is, the water vapor content in hydrogen gas increases more than before. And after step S140, it escapes from a "return" and the above-mentioned processing is repeated.
[0048] Thus, if it is made in charge of the interior temperature TTANK of a tank rising, reduction control of the cooling-medium flow rate is carried out so that the temperature change of the interior temperature TTANK of a tank accompanying the increase of a flow rate of a cooling medium may become about +5 degrees C of maxes to the temperature TPEFC near the electrolyte membrane.
[0049] Therefore, since processing is repeated at the time of steady operation which consists of step S132-140 when PEFC12 is in steady operation, according to the damp or wet condition inside a cell, temperature control of the interior temperature TTANK of a tank of the buffer tank 18 is carried out. For this reason, when PEFC12 is in a steady operation condition, since temperature control of the hydrogen gas (before or after about 260 degrees C) which flowed into the buffer tank 18 is carried out through heat exchange with the cooling medium in the buffer tank 18, that amount of mixture is adjusted according to the damp or wet condition inside a cell through coagulation [in / in the steam in hydrogen gas / the buffer tank 18].
[0050] Therefore, from the gas discharge port 52 of the buffer tank 18, if the damp or wet condition inside a cell is the excess of moisture, hydrogen gas with few amounts of steam mixture than before will be supplied to PEFC12, and the excess of moisture will be canceled. Moreover, if moisture is insufficient, hydrogen gas with more amounts of steam mixture than before will be supplied to PEFC12, and

the lack of moisture will be canceled. And if the excess of moisture or the lack of moisture is canceled, the intermingled hydrogen gas will continue the steam of a constant rate, and PEFC12 will be supplied.

[0051] And since accommodation of such an amount of steam mixture is performed through removal of the steam which passed through the coagulation and waterdrop-ization of the steam in hydrogen gas in the buffer tank 18, in the hydrogen gas supplied to PEFC12, moisture is intermingled as a steam, and moisture is not supplied to PEFC12 with hydrogen gas as waterdrop.

[0052] When the fuel cell system 10 is in ON condition of a system, although drive control of PEFC12 contained in the system concerned, the methanol reformer 20, and the buffer tank 18 is carried out as described above, the fuel cell system 10 results [from ON condition of a system] in an OFF condition in response to ON of OFF of a main switch, an emergency stop switch, etc. Then, as shown in drawing 3 , at step S100 of this routine, negative judgment is carried out and it shifts to the following step S145.

[0053] When the fuel cell system 10 is in an OFF condition, even if the OFF condition of the case where it changes to an OFF condition from ON condition which the fuel cell system 10 described above, and a system may be continuing and it is the case where they are these both, negative judgment is drawn at step S100. Then, at step S145 following the negative judgment of step S100, it judges again whether the value of ON condition continuation flag FON is 1 that it should judge whether it is in which OFF condition. In addition, also when each [others and] device, for example, PEFC12 and the methanol reformer 20, when a system is in an OFF condition and all the devices that constitute a system serve as OFF, and buffer tank 18 grade are in an OFF condition, it corresponds.

[0054] And if negative judgment (FON=0) is carried out at this step S145, since this ON condition continuation flag FON will not be made into a value 1 only in the system starting transition stage processing after ON of a system, it is the case where it is continuing from the beginning with FON=0 (i.e., the OFF condition of the fuel cell system 10). Therefore, when negative judgment is carried out at step S145, it escapes from a "return" and the above-mentioned processing is repeated.

[0055] However, since it is the case where the condition of the fuel cell system 10 changes to an OFF condition from ON condition when affirmative judgment is carried out at step S145 (FON=1), it shifts to the system stop transition stage processing (step S150) which consists of two or more processings described below. And if the processing concerned is completed, it will escape from a "return" and the above-mentioned processing will be repeated. While this system stop transition stage processing is in OFF of a main switch in this system stop transition stage for the purpose of stopping the fuel cell system 10 which was under operation till then in the good condition in consideration of the time of that reboot, lowering gradually temperature TPEFC near the electrolyte membrane of PEFC12 in OFF of a main switch (descent) is also taken into consideration.

[0056] If it explains in more detail, each configuration equipment of PEFC12, the methanol reformer 20, and the fuel cell system 10 of buffer tank 18 grade will not be altogether set to OFF uniformly in OFF of a main switch. And while preventing

that the residue gas intermingled in the steam flows into PEFC12 from the methanol reformer 20 interlocked and stopped by not setting each configuration equipment to OFF uniformly at OFF of the switch concerned, and a steam condenses within PEFC12 In order to aim at removal of the excessive steam in the residue gas, while after OFF of a main switch is for a while, it controls to combine the interior temperature TTANK of a tank of the buffer tank 18 with the fall of the temperature TPEFC near the electrolyte membrane of PEFC12, and to reduce it.
[0057] That is, to be shown in drawing 6 , the interior temperature TTANK of a tank is similarly followed even with step S112-120 in system starting transition stage processing at descent of the temperature TPEFC near the electrolyte membrane, and it controls by system stop transition stage processing of this step S150. First, the interior temperature TTANK of a tank and the temperature TPEFC near the electrolyte membrane are inputted (step S152), both temperature is measured after that (step S154), and it judges whether the interior temperature TTANK of a tank is temperature higher than the temperature TPEFC near the electrolyte membrane.
[0058] Here, if affirmative judgment is carried out, control-objectives temperature of the internal temperature of the buffer tank 18 will be made into the temperature TPEFC near the electrolyte membrane of PEFC12 inputted at step S152, and drive control of the positive crankcase ventilation valve 65 of the cooling medium of the buffer tank 18 will be carried out at a flow rate increase side according to the difference of the temperature TPEFC near the electrolyte membrane, and the interior temperature TTANK of a tank (step S156). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become many flow rates. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 increases according to a temperature gradient, the interior temperature TTANK of a tank will descend. In addition, if step S156 is followed, the below-mentioned step S162 is performed.
[0059] On the other hand, when negative judgment is carried out at step S154, it judges whether the difference of TPEFC and TTANK is below the predetermined value alpha (step S158). That is, if negative judgment is carried out at step S154, it will be TTANK<=TPEFC, but if it explains to a detail more, it will judge whether the temperature gradient is proper or the interior temperature TTANK of a tank is not too low compared with the temperature TPEFC near the electrolyte membrane. If affirmative judgment is carried out at this step S158, the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, and it will shift to the below-mentioned step S162 noting that it does not have to carry out modification control of the interior temperature TTANK of a tank, since that temperature gradient is proper.
[0060] On the other hand, if negative judgment is carried out at step S158, although the interior temperature TTANK of a tank is below the temperature TPEFC near the electrolyte membrane, TTANK will be too low compared with TPEFC. Therefore, drive control of the positive crankcase ventilation valve 65 of

the cooling medium of the buffer tank 18 is carried out at a flow rate reduction side in order to carry out the temperature up of the interior temperature TTANK of a tank so that the temperature TPEFC near the electrolyte membrane may be approached (step S160). Under the present circumstances, the control signal according to the temperature gradient of TPEFC and TTANK is outputted to a positive crankcase ventilation valve 65, and drive control of the positive crankcase ventilation valve 65 is carried out so that a temperature gradient is large, and it may become a decrease of a flow rate. For this reason, since the flow rate of the cooling medium which passes through the cooling-medium passage 62 of the buffer tank 18 decreases according to a temperature gradient, the interior temperature TTANK of a tank will rise.
[0061] And if step S156,158 and step S160 are followed, based on the elapsed time after a main switch is set to OFF etc., it judges whether the fuel cell system 10 is in a system stop transition stage, or it is during continuation of a halt (step S162). Here, without performing new processing, it escapes from a "return" and each above-mentioned processing is repeated noting that it will still be a system stop transition stage, if negative judgment is carried out.
[0062] If affirmative judgment is carried out at step S162, since the fuel cell system 10 will halt be under continuation from having escaped from the system stop transition stage and having resulted during continuation of a halt, or the beginning on the other hand, a value 0 is set to ON condition continuation flag FON (step S164). Thus, if FON=0, since negative judgment will be carried out at step S105 of this subsequent routine (refer to drawing 3), it will continue, by the time a value 0 is set to FON at this step S164, and system stop transition stage processing which consists of the above-mentioned processing to step S152-164 is performed repeatedly.
[0063] Therefore, since the system stop transition stage processing which consists of step S152-164 is repeated and the temperature TPEFC near the electrolyte membrane falls gradually in the meantime while the fuel cell system 10 is in a system stop transition stage, temperature fall control of the buffer tank 18 is carried out from the temperature under continuation of operation so that the interior temperature TTANK of a tank may turn into temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12. For this reason, when a system is made into an OFF condition in response to OFF of a main switch etc., the residue gas which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which is temperature lower than the temperature TPEFC near the electrolyte membrane of PEFC12 through heat exchange with a cooling medium. And the temperature TPEFC near the electrolyte membrane descends gradually in this case. Therefore, the residue gas which flowed into the buffer tank 18 is made into the interior temperature TTANK of a tank which descended collectively to descent of the temperature TPEFC near the electrolyte membrane. Consequently, in the buffer tank 18, the steam in residue gas is made into the saturation state in temperature lower than TPEFC, and a superfluous steam is solidified, serves as waterdrop within the buffer tank 18, and is removed out of the path of the hydrogen gas supply duct 16. Moreover, to descent of the temperature TPEFC

near the electrolyte membrane, the water vapor content in the residue gas supplied to PEFC12 will be combined, and will decrease.

[0064] Therefore, from the gas discharge port 52 of the buffer tank 18, the residue gas intermingled by the saturation state is supplied to PEFC12 in a steam at temperature only with predetermined temperature (alpha) lower than the temperature TPEFC near the electrolyte membrane of PEFC12 at that time. For this reason, in the case of a system stop, while moisture is not supplied as waterdrop, since it is TPEFC>TTANK, inside a cell, a steam condenses and does not waterdrop-ize. Therefore, in the case of a system stop, moisture does not remain as waterdrop inside a cell.

[0065] As explained above, in the fuel supply system of the fuel cell of this example, accommodation of the amount of steam mixture in the hydrogen gas which supplies moisture as a steam is performed to PEFC12 through removal of the steam which passed through accommodation of the interior temperature TTANK of a tank of the buffer tank 18. Consequently, according to the fuel supply system of the fuel cell of this example, accommodation of the amount of steam mixture in hydrogen gas can be ensured, and stabilization of the output of a fuel cell can be attained.

[0066] Moreover, in the fuel supply system of the fuel cell of this example, in the case of a system stop, moisture is not supplied to PEFC12 as waterdrop, but the coagulation of the steam in the gas in PEFC12 is avoided. For this reason, according to the fuel supply system of the fuel cell of this example, degradation of the catalyst which in the case of the system stop moisture did not remain as waterdrop inside the cell and was applied at the interface of the solid-state polyelectrolyte film / electrode zygote of PEFC12, the corrosion of the gas piping in PEFC12, etc. are certainly avoidable.

[0067] Moreover, even if it is in the case of a system stop, moisture is supplied as a steam. Therefore, according to the fuel supply system of the fuel cell of this example, the so-called dry rise of the unprepared solid-state polyelectrolyte film can be avoided, and the starting characteristic at the time of a reboot can be raised.

[0068] Furthermore, in the fuel supply system of the fuel cell of this example, moisture is not supplied to PEFC12 as waterdrop in the starting transition stage of a system, but, moreover, the coagulation of the steam in the hydrogen gas in PEFC12 is avoided. For this reason, since according to the fuel supply system of the fuel cell of this example the electrode surface joined to the solid-state polyelectrolyte film of PEFC12 is not blockaded with waterdrop and transparency of the hydrogen gas to the film is not checked, while being able to raise the starting characteristic, proper output voltage can be obtained within an early stage from the early stages of starting.

[0069] Moreover, it is a saturation state about the steam in hydrogen gas, and the rise of the temperature TPEFC near the electrolyte membrane is made to increase the amount to the starting transition stage of a system collectively. Therefore, according to the fuel supply system of the fuel cell of this example, PEFC12 can be more quickly made steady operation through rationalization of the damp or wet condition inside the cell over between the rises of the temperature TPEFC near

the electrolyte membrane.
[0070] In addition, when PEFC12 is in steady operation, even if it is, moisture is not supplied to PEFC12 as waterdrop, but the hydration to the solid-state polyelectrolyte film of PEFC12 is provided with the fuel supply system of the fuel cell of this example with the steam of a saturation state. For this reason, since according to the fuel supply system of the fuel cell of this example the electrode surface joined to the solid-state polyelectrolyte film of PEFC12 is not blockaded with waterdrop and transparency of the hydrogen gas to the film is not checked, the output stabilized through a smooth advance of the electrode reaction at the time of steady operation can be obtained.
[0071] Moreover, in the fuel supply system of the fuel cell of this example, when PEFC12 is in steady operation, the amount of mixture of the steam in hydrogen gas is adjusted according to the damp or wet condition inside a cell. For this reason, according to the fuel supply system of the fuel cell of this example, the interior of a cell can obtain the output canceled and stabilized [lack / of moisture / the excess of moisture of a through lever, or] in adjustment of the amount of steam mixture in hydrogen gas, even if the output of PEFC12 falls to the excess of moisture, or the lack of moisture very much.
[0072] Here, an evaluation trial with the fuel supply system (conventional example) with which the above-mentioned accommodation of the fuel supply system of this example and the amount of steam mixture is not performed, but the amount of steam mixture supplies the hydrogen gas of regularity (the amount of steam mixture required for a steady state) is explained. This evaluation trial was performed by measuring that output for every elapsed time from starting, when the output at the time of steady operation of PEFC12 (current value) was set to 100. The result is shown in drawing 7 .
[0073] According to the fuel supply system of this example, the output rose smoothly from the time of starting, and when 15 minutes passed, about 90% of output at the time of a stationary was able to be obtained so that clearly from this drawing 7 . And about 100% of output was able to be continued and obtained after 30-minute progress. However, in the conventional example, although the output started rapidly in early stages of starting, the output declined gradually after 10-minute progress. And the output at the 10-minute progress time was only about 67% at the time of a stationary. Therefore, according to the fuel supply system of this example, it became clear that the stable output could be obtained. In addition, the situation of the output observed with the fuel supply system of the conventional example can be explained as follows.
[0074] In the conventional example, since the amount of steam mixture is not adjusted, although the temperature is low to a fuel cell, a lot of steams are supplied to it. For this reason, cell resistance falls temporarily and an output is improved rapidly. However, after that, it solidifies and waterdrop-izes inside a fuel cell, and an electrode is blockaded or a superfluous steam causes the rise of cell resistance. For this reason, an output declines gradually, without going up to the output at the time of a stationary.
[0075] Moreover, according to the fuel supply system of the fuel cell of this example, there are the following advantages. That is, the water which the steam

waterdrop-ized is returned to a water tank 30 through the water cycle duct 60 with the pump 58 for circulation by the buffer tank 18, and it is made to circulate in the fuel supply system of the fuel cell of this example as water supplied to the methanol reformer 20. For this reason, according to the fuel supply system of the fuel cell of this example, the use effectiveness of water can be raised.

[0076] Next, other examples are explained. First, the fuel supply system of the 2nd example is explained. That configuration is different at the point made into the oxygen content gas (air) to which the cooling medium of the buffer tank 18 in the fuel cell system 10 which described above the fuel supply system of this 2nd example is supplied by PEFC12 through the oxygen gas supply line 14. That is, as shown in drawing 8 , the feeding pump 80 of air is formed in the oxygen gas supply line 14 which supplies air to PEFC12 from that upstream, and let this oxygen gas supply line 14 be the branched pipes 14a and 14b which join on the lower stream of a river of the buffer tank 18 on the lower stream of a river of the pump concerned. The positive crankcase ventilation valves 81 and 82 which adjust the flow rate which passes through the duct concerned are formed in each branched pipes 14a and 14b. In addition, as a feeding pump 80, the atmospheric-air pressurization feeder by the compressor can be illustrated. Moreover, out of the feeding pump 80, the gas transfer unit which used for example, the high-pressure air chemical cylinder and the liquid air tank can also be used.

[0077] It connects with the external piping 63 (refer to drawing 2) of the buffer tank 18, and while the air which passes this branched pipe 14b acts as the connoisseur of the cooling-medium passage 62 of the buffer tank 18, heat exchange with hydrogen gas is presented with branched pipe 14b of the side in which the positive crankcase ventilation valve 82 was formed. Moreover, the humidifier 83 which humidifies the air which passes through a duct in this oxygen gas supply line 14 is formed in the juncture lower stream of a river of each branched pipe. in addition -- if this humidifier 83 can humidify the air which passes through a duct -- **** -- a configuration [like] may be used, and although it lets the humidifier of the method which atomizes water besides the humidifier by the bubbling method in a direct gas air current, and gas-like water (steam) pass, liquid-like water may adopt which humidifiers, such as a humidifier of the method humidified using the porous membrane which it does not let pass. Thus, when air temperature falls by humidifying with a humidifier 83, the air which carried out the temperature up to predetermined temperature can be supplied to PEFC12 by using a heating means together with a humidifier.

[0078] With the fuel supply system of the 2nd example of the above-mentioned configuration, the flow rate of the air which passes through the cooling-medium passage 62 of the buffer tank 18 can be adjusted by controlling the flow rate by carrying out drive control of the positive crankcase ventilation valves 81 and 82 of each branched pipes 14a and 14b with the control signal from an electronic control 70, for example. For this reason, according to the fuel supply system of the 2nd example, in addition to stabilization of the fuel cell output by accommodation of the amount of steam mixture in the hydrogen gas through accommodation of the interior temperature of a tank of the buffer tank 18, the air which carried out the temperature up by the buffer tank 18 can be supplied to PEFC12. Therefore, the

output which made electrode reaction further carried out smoothly, and was stabilized can be obtained through temperature up accommodation of air temperature. Moreover, the special equipment for carrying out the temperature up of the air supplied to PEFC12 is not needed, but simplification of a configuration can be attained.

[0079] Next, the fuel supply system of the 3rd example is explained. That configuration is different at the point which used as the cooling water of PEFC12 the cooling medium of the buffer tank 18 in the fuel cell system 10 which described above the fuel supply system of this 3rd example. That is, as shown in drawing 9 , the cooling water pump 85 which adjusts the cooling water flow rate of the cooling-water-flow duct 84 according to the temperature TPEFC near the electrolyte membrane of PEFC12 which the cell side temperature sensor 72 (refer to drawing 1) detected, and the radiator 86 which cools the cooling water of the duct concerned to predetermined temperature through heat dissipation (maintenance) are formed in the cooling-water-flow duct 84 which carries out circulation supply of the cooling water in the cooling water passage which PEFC12 does not illustrate. Moreover, the tank cooling-water-flow duct 87 connected to the external piping 63 (refer to drawing 2) of the buffer tank 18 is established in the cooling-water-flow duct 84 so that it may branch from the cooling-water-flow duct 84 on the lower stream of a river of a cooling water pump 85 and the cooling-water-flow duct 84 may be joined in the upstream of a radiator 86. And the positive crankcase ventilation valve 88 which adjusts the flow rate which passes through the duct concerned is formed in this tank cooling-water-flow duct 87.

[0080] Therefore, while the fuel cell cooling water which passes through the tank cooling-water-flow duct 87 acts as the connoisseur of the cooling-medium passage 62 of the buffer tank 18, heat exchange with hydrogen gas is presented. For this reason, with the fuel supply system of the 3rd example, the flow rate of the cooling water which passes through the cooling-medium passage 62 of the buffer tank 18 can be adjusted by carrying out drive control of the positive crankcase ventilation valve 88 of the tank cooling-water-flow duct 87 with the control signal from an electronic control 70. Consequently, according to the fuel supply system of the 3rd example, like the 1st example mentioned already, the amount of steam mixture in hydrogen gas can be adjusted through accommodation of the interior temperature of a tank of the buffer tank 18, and stabilization of a fuel cell output can be attained. Moreover, the special equipment only for supplying the heat exchange medium in the buffer tank 18 is not needed, but simplification of a configuration can be attained.

[0081] Next, the fuel supply system of the 4th example is explained. That configuration is different at the point using the air dryer from which the fuel supply system of this 4th example contains water absorbing polymer resin, a porous body particle, etc., adsorbs the steam in gas at these instead of the buffer tank 18 which waterdrop[coagulation and]-izes the steam in hydrogen gas by heat exchange, and adjusts the amount of steam mixture in hydrogen gas, and the steam in hydrogen gas is removed. That is, as shown in drawing 10 , let the hydrogen gas supply ducts 16 which supply hydrogen gas to PEFC12 be the branched pipes 16a and 16b which branch on the lower stream of a river of the methanol reformer 20,

and join between the methanol reformer 20 and PEFC12 in PEFC12 this side. The positive crankcase ventilation valves 89 and 90 which adjust the flow rate which passes through the duct concerned are formed in each branched pipes 16a and 16b. And the air dryer 91 from which the steam in gas is adsorbed on the lower stream of a river of a positive crankcase ventilation valve 90, and the steam in hydrogen gas is removed is formed in branched pipe 16b. This air dryer 91 has the capacity which dehumidifies a fixed steam per [which passes the equipment concerned] unit flow rate of hydrogen gas with the amount and property of the water absorbing polymer resin to build in. For this reason, the amount of steam removal can be adjusted by changing the flow rate of the hydrogen gas which passes an air dryer 91.

[0082] In the fuel supply system of the 4th example of the above-mentioned configuration, the amount of steam mixture in the hydrogen gas which each branched pipe joins and results in PEFC12 can be adjusted through the steam removal by the air dryer 91 by controlling the flow rate by carrying out drive control of the positive crankcase ventilation valves 89 and 90 of each branched pipes 16a and 16b with the control signal from an electronic control 70, for example. For this reason, according to the fuel supply system of the 4th example, stabilization of a fuel cell output can be attained. In addition, the air dryer which has different dehumidification capacity from the air dryer 91 of branched pipe 16b can be formed in the lower stream of a river of a positive crankcase ventilation valve 89 also at branched pipe 16a, and it can also constitute so that drive control of the positive crankcase ventilation valves 89 and 90 of each branched pipes 16a and 16b may be carried out with the control signal from an electronic control 70.

[0083] Although one example of this invention was explained above, as for this invention, it is needless to say that it can carry out in the mode which becomes various in the range which is not limited to such an example at all and does not deviate from the summary of this invention.

[0084] for example, system stop transition stage processing -- setting -- the interior temperature TTANK of a tank -- below the temperature TPEFC near the electrolyte membrane -- the temperature gradient -- being proper (alpha) -- temperature fall control was carried out so that it might become, but (step S158,160) it can also constitute so that it may become the temperature below the temperature TPEFC near the electrolyte membrane and temperature fall control of the interior temperature TTANK of a tank may be carried out. That is, what is necessary is to skip step S158 in system stop transition stage processing, and just to shift to step S160, when negative judgment is carried out at step S154.

[0085] In addition, although the amount of steam mixture in hydrogen gas was adjusted by removing out of a hydrogen gas pipe way, in order to attain stabilization of the output of a fuel cell, steam removal and steam mixing can be used together and it can also constitute from an above-mentioned example as follows.

[0086] Namely, are the fuel supply system which supplies this hydrogen gas, and steam reforming of the hydrocarbon compound is carried out to the fuel cell which makes hydrogen gas fuel gas. A reforming means to generate hydrogen gas in the state of mixture of a steam, and a supply means to supply the this generated

hydrogen gas to said fuel cell with said steam, An operational status detection means to detect the operational status of said fuel cell, and a damp or wet condition judging means to judge the damp or wet condition of said fuel cell based on the this detected operational status, It has the amount increase-and-decrease of steam mixture means of accommodation which carries out increase and decrease of the amount of steam mixture in the hydrogen gas supplied to said fuel cell of accommodation according to said judged damp or wet condition.
[0087] In this case, the amount increase-and-decrease of steam mixture means of accommodation which carries out increase and decrease of the amount of steam mixture of accommodation is realized by using together the steam stripper of the buffer tank 18 in each above-mentioned example, or air dryer 91 grade, and steam mixing equipments, such as humidification equipment.
[0088] With the fuel supply system of this fuel cell, in adjusting the amount of steam mixture in the hydrogen gas supplied to a fuel cell, a steam is mixed into hydrogen gas or increase and decrease of the amount of steam mixture of accommodation are carried out by removing. And this increase and decrease of adjustment are performed according to the damp or wet condition of the fuel cell judged based on the operational status of a fuel cell. For this reason, if the humidity of a fuel cell is excessive, the amount of steam mixture in the hydrogen gas supplied can be adjusted fewer by removal of a steam, and the excess of humid can be avoided. On the other hand, if the humidity of a fuel cell is insufficient, more amounts of steam mixture in the hydrogen gas supplied can be adjusted by addition of a steam, and the lack of humid can be avoided. Consequently, the output which let Lycium chinense pass at the suitable damp or wet condition, and was stabilized in the fuel cell can always be obtained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the fuel cell system which applied the fuel supply system of the 1st example.
[Drawing 2] The outline sectional view of the buffer tank 18 in the fuel supply system of the 1st example.
[Drawing 3] The flow chart of the fuel cell system operation routine performed in the fuel cell system 10.
[Drawing 4] The detail flowchart of the system starting transition stage processing in a fuel cell operation routine.
[Drawing 5] It is the detail flowchart of processing at the time of steady operation in a fuel cell operation routine.
[Drawing 6] The detail flowchart of the system stop transition stage processing in a fuel cell operation routine.
[Drawing 7] The graph which shows the result of evaluation with the fuel supply system of an example, and the fuel supply system of the conventional example.
[Drawing 8] The important section block diagram of the fuel cell system which applied the fuel supply system of the 2nd example.
[Drawing 9] The important section block diagram of the fuel cell system which applied the fuel supply system of the 3rd example.
[Drawing 10] The important section block diagram of the fuel cell system which applied the fuel supply system of the 4th example.
[Description of Notations]
10 -- Fuel cell system
12 -- PEFC
14 -- Oxygen gas supply line
14a, 14b -- Branched pipe
16 -- Hydrogen gas supply duct
16a, 16b -- Branched pipe
18 -- Buffer tank
20 -- Methanol reformer
26 -- Methanol tank
28 -- Feeding pump
30 -- Water tank
32 -- Feeding pump

53 -- Tanggu temperature sensor
58 -- Pump for circulation
60 -- Water cycle duct
62 -- Cooling-medium passage
63 -- External piping
65 -- Positive crankcase ventilation valve
66 -- Spherical packing object
70 -- Electronic control
72 -- Cell side temperature sensor
74 -- Voltmeter
76 -- Impedance meter
80 -- Feeding pump
81 82 -- Positive crankcase ventilation valve
83 -- Humidifier
84 -- Cooling-water-flow duct
85 -- Cooling water pump
86 -- Radiator
87 -- Tank cooling-water-flow duct
88 -- Positive crankcase ventilation valve
89 90 -- Positive crankcase ventilation valve
91 -- Air dryer

[Translation done.]

* NOTICES *

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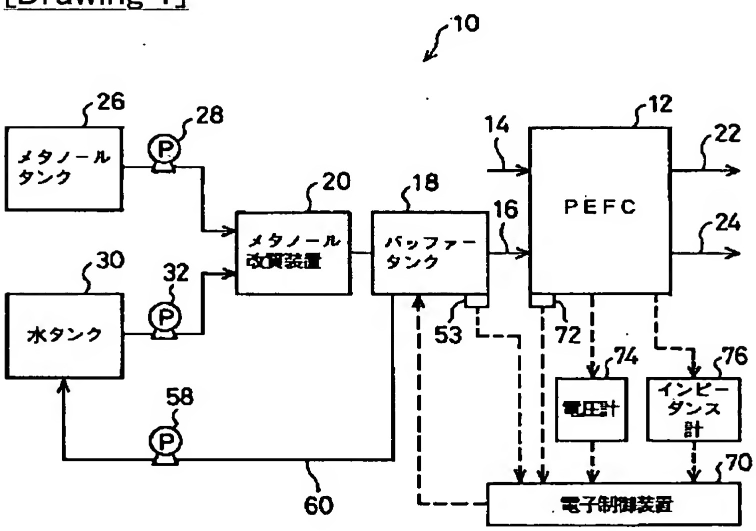
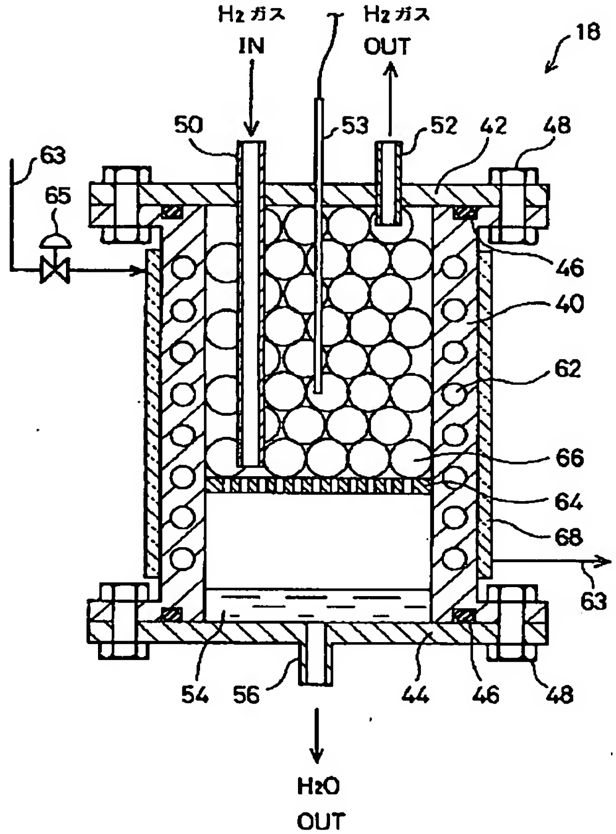
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

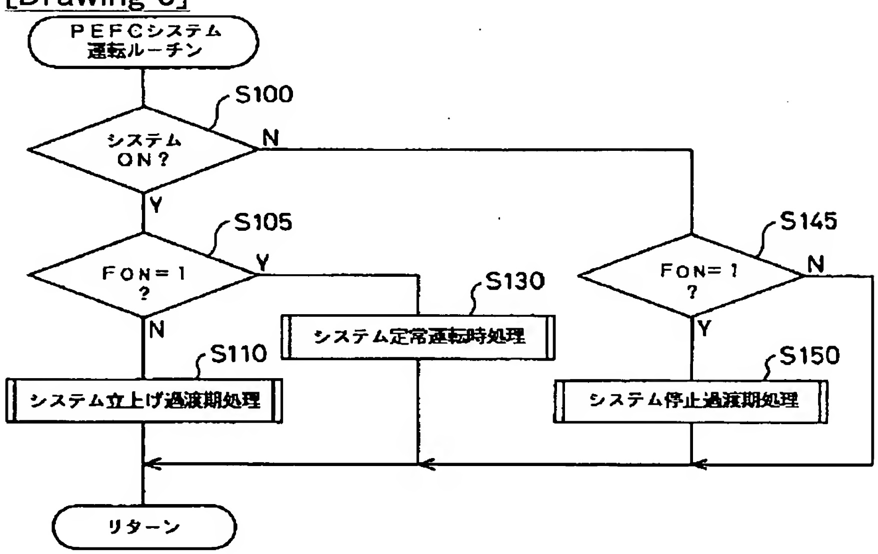
[Drawing 1]



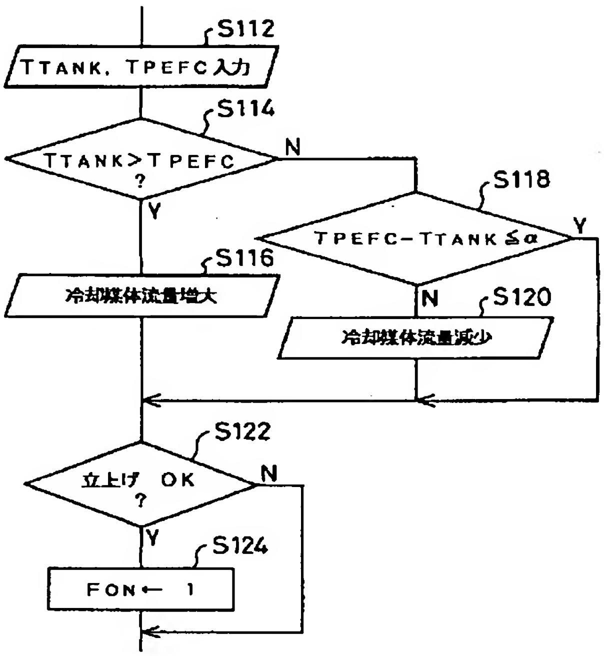
[Drawing 2]



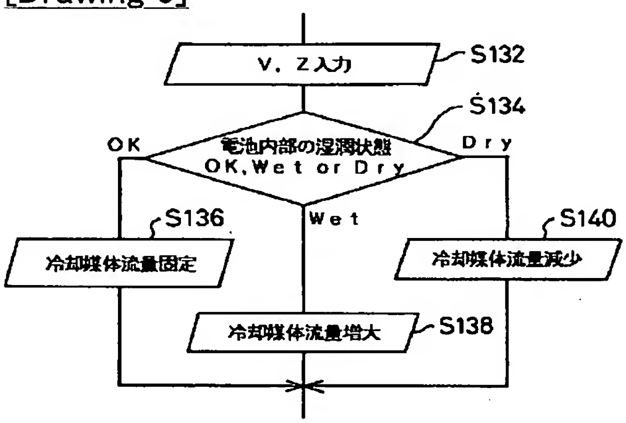
[Drawing 3]



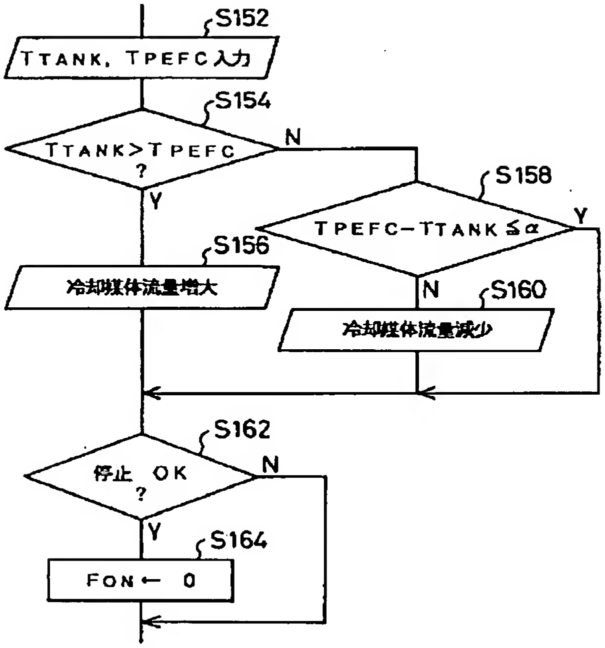
[Drawing 4]



[Drawing 5]



[Drawing 6]



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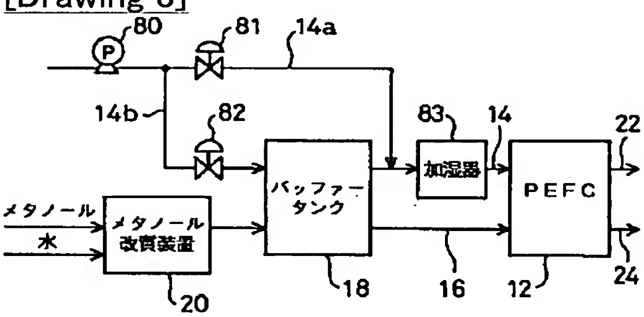

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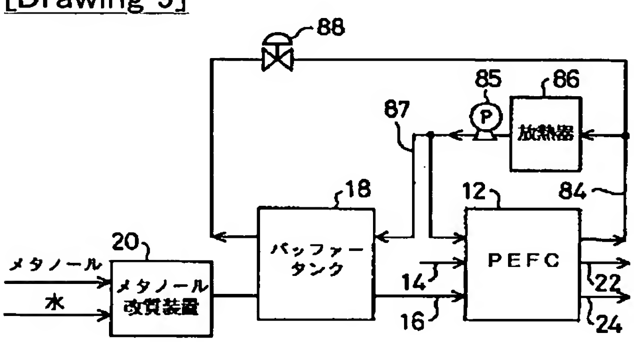

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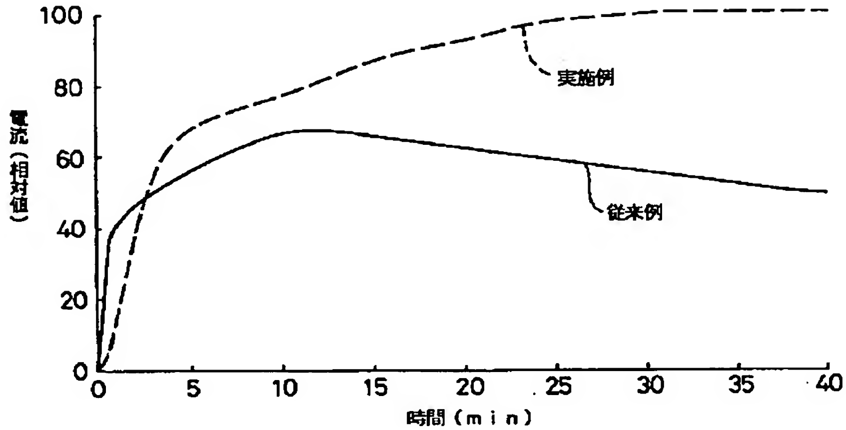

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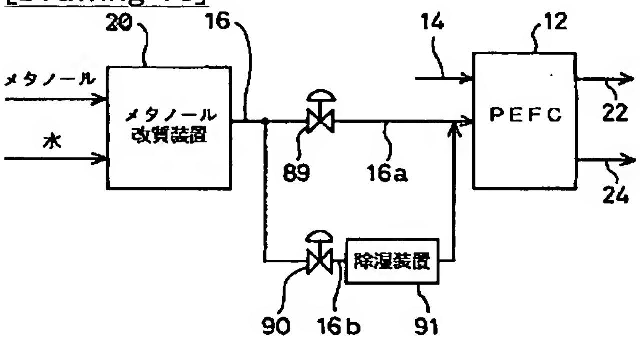

[Translation done.]

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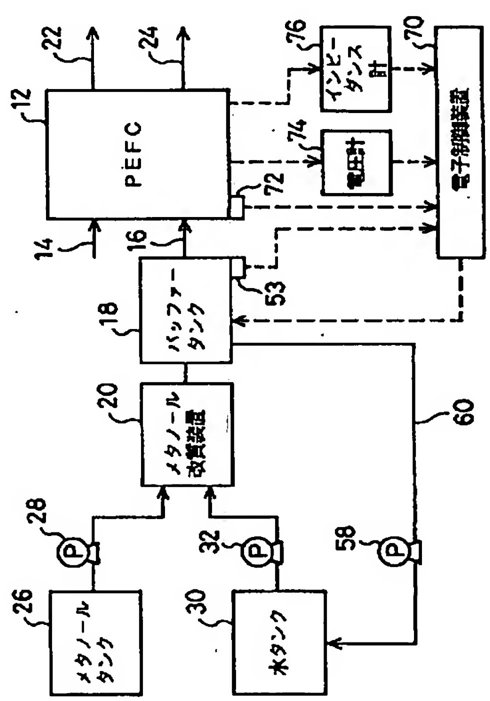
(54)【発明の名称】　燃料電池の燃料供給装置

(57)【要約】

【目的】　水素ガスを燃料ガスとする燃料電池の出力の安定化を図る。

【構成】　ＰＥＦＣ１２には、酸素ガス供給管路１４からは酸素含有ガスである空気が、水素ガス供給管路１６からはメタノールを水蒸気改質して得られた水素ガスが、それぞれ供給される。水素ガス供給管路１６の管路には、水素ガス中の水蒸気混在量を調節するバッファータンク１８と、メタノール改質装置２０とが設けられている。このバッファータンク１８は、タンクの冷却媒体流路を通過する冷却媒体の流量等によりタンク内部温度が制御可能に構成されている。そして、バッファータンク１８のタンク内部温度を調節することで、水素ガス温度の調節を通してガス中の水蒸気混在量を調節し、水蒸気混在量調節済みの水素ガスをＰＥＦＣ１２に供給する。



【特許請求の範囲】
【請求項１】　水素ガスを燃料ガスとする燃料電池に該水素ガスを供給する燃料供給装置であって、
炭化水素化合物を水蒸気改質して、水素ガスを水蒸気の混在状態で生成する改質手段と、
該生成された水素ガスを前記水蒸気とともに前記燃料電池に供給する供給手段と、
該供給される水素ガスの経路において前記水蒸気を除去し、前記燃料電池に供給される水素ガス中の水蒸気混在量を調節する水蒸気混在量調節手段とを備えることを特徴とする燃料電池の燃料供給装置。
【請求項２】　請求項１記載の燃料電池の燃料供給装置であって、
前記燃料電池の運転状態を検出する運転状態検出手段と、
該検出した運転状態に基づいて前記燃料電池の湿潤状態を判定する湿潤状態判定手段と、
該判定した湿潤状態に応じて前記水蒸気混在量調節手段を制御する制御手段とを備える燃料電池の燃料供給装置。
【請求項３】　請求項１記載の燃料電池の燃料供給装置であって、
前記水蒸気混在量調節手段は、
前記水素ガスの経路に設けられ、水素ガスが水蒸気とともに流入する緩衝容器と、
該緩衝容器の内部温度を制御する温度制御部とを有する燃料電池の燃料供給装置。
【請求項４】　請求項３記載の燃料電池の燃料供給装置であって、
前記緩衝容器は、前記燃料電池に供給される酸素含有ガスが通過する流体経路を容器内部との間で熱交換が行なえるように構成され、
前記温度制御部は、前記流体経路を通過する前記酸素含有ガス量を制御するものである燃料電池の燃料供給装置。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、水素ガスを燃料ガスとする燃料電池に該水素ガスを供給する燃料供給装置に関する。
【０００２】
【従来の技術】一般に、水素ガスを燃料ガスとする燃料電池は、水素イオンをH^+（xH_2O）の水和状態で透過する電解質と電極とを有し、電極反応を促進させるための触媒層を介在させてこの電解質を電極で挟持して備える。このような燃料電池は、用いる電解質の種類により種々のもの（例えば、固体高分子型燃料電池，りん酸型燃料電池等）があるが、陽陰の電極において進行する電極反応に差はなく、各極で進行する電極反応は、以下の通りである。
陰極（水素極）：
$2H_2 \rightarrow 4H^+ + 4e^-$　…①
陽極（酸素極）：
$4H^+ + 4e^- + O_2 \rightarrow 2H_2O$　…②
【０００３】そして、陰極に燃料ガスである水素ガスが供給されると、陰極では①の反応式が進行して水素イオンが生成する。この生成した水素イオンがH^+（xH_2O）の水和状態で電解質（固体高分子型燃料電池であれば固体高分子電解質膜）を透過（拡散）して陽極に至り、この陽極に酸素含有ガス、例えば空気が供給されていると、陽極では②の反応式が進行する。この①，②の電極反応が各極で進行することで、燃料電池は起電力を呈することになる。
【０００４】燃料電池の電解質は、水素イオンが上記した水和状態で陰極側から陽極側に電解質を透過（拡散）する都合上、陰極側で水分が不足する状態となる。また、固体高分子型燃料電池に用いられる固体高分子電解質膜は、適度な湿潤状態にあれば良好な電気伝導性（イオン導電性）を発揮するが、含水率が低下するとイオン導電性が悪化して電解質として機能しなくなり、場合によっては電極反応を停止させてしまう。また、含水率が高すぎてもイオン導電性が悪化する傾向がある。このため、陰極には、燃料ガスとしての水素ガスを供給するとともに、適当な量の水を常時補給する必要がある。従って、燃料電池には、水蒸気にて加湿した水素ガスが燃料供給装置から供給されている。
【０００５】燃料供給装置から水蒸気加湿された水素ガスを燃料電池に供給するには、種々の方法があり、最も単純な方法として、次のような技術がよく知られている。つまり、メタノール等の炭化水素化合物を水蒸気改質して水素ガスを生成するに当たり、メタノールと水との改質反応応は等モル反応であるため、メタノールに対して若干余剰の水を供給して改質反応を起こさせ、余剰の水に相当する量の水蒸気で水素ガスを加湿する方法である。また、特開平３－２６９９５５では、生成した水素ガスを熱交換して降温し、降温後の水素ガス中に燃料電池の手前で水蒸気を添加し、水蒸気添加により加湿した水素ガスを燃料電池に供給する技術が提案されている。
【０００６】
【発明が解決しようとする課題】しかしながら、メタノールに対して若干余剰の水を供給し水分過多の状態で改質反応を起こさせ加湿する場合には、次のような不具合がある。例えば、余剰水の量を固定する場合、燃料電池の加湿不足を回避するためには、燃料電池の発電時に最大限必要とされる水分を水蒸気で供給する必要がある。よって、定量の余剰水を供給して改質反応を起こさせる必要があるが、改質反応の進行程度によっては水素ガス中の水蒸気量が変動したり、燃料電池の発電状態によっては水分過多となって電解質膜がいわゆる濡れすぎとな

るため、電極反応が低下し電池性能の低下を招くことがある。

【０００７】また、改質反応に用いる水の量の増減調節を通して水素ガス中の水蒸気量、即ち燃料電池の加湿程度を調節することも可能であるが、次のような理由から現実的ではない。即ち、供給水量の調節を減少側に行なう場合には、メタノールに対して水のモル数が少なくなるため、改質反応の中間生成物である一酸化炭素の発生頻度が増し、この一酸化炭素が燃料電池の陰極に供給されることになる。このように一酸化炭素が陰極に至ると、電極反応を促進させるために設けられている触媒層の触媒が一酸化炭素により被毒され、触媒としての機能が低下してしまう。このため、電極反応の停止、延いては燃料電池の運転停止を招く。

【０００８】一方、特開平３－２６９９５５に提案されているように、改質ガスの温度を燃料電池の温度と略同じ程度に下げ、その下げた改質ガスに別途水を添加する技術では、温度を下げるための熱交換器と、水を添加する加湿器との両方が必要となり、システムのコンパクト化を図ることが困難であった。また、単純に熱交換器を省くと、加湿器に供給される改質ガスの温度が高温（約２５０～３００℃）であることに起因して、所望の加湿状態に制御することが困難になるという問題があった。例えば、一般的な加湿器であるバブラーを用いた場合、バブラー内の水によって改質ガスが急激に冷却されるために、改質ガスが保有している水分がバブラー内に添加されバブラーの水管理が難しくなるほか、改質ガスによってバブラー内の水自体の温度が影響を受け、加湿量をコントロールし難くなるという問題があった。

【０００９】本発明は、上記問題点を解決するためになされ、水素ガスを燃料ガスとする燃料電池の出力の安定化を図ることを目的とする。

【００１０】

【課題を解決するための手段】かかる目的を達成するための請求項１記載の燃料電池の燃料供給装置で採用した手段は、水素ガスを燃料ガスとする燃料電池に該水素ガスを供給する燃料供給装置であって、炭化水素化合物を水蒸気改質して、水素ガスを水蒸気の混在状態で生成する改質手段と、該生成された水素ガスを前記水蒸気とともに前記燃料電池に供給する供給手段と、該供給される水素ガスの経路において前記水蒸気を除去し、前記燃料電池に供給される水素ガス中の水蒸気混在量を調節する水蒸気混在量調節手段とを備えることをその要旨とする。

【００１１】この場合、請求項２記載の燃料電池の燃料供給装置では、前記燃料電池の運転状態を検出する運転状態検出手段と、該検出した運転状態に基づいて前記燃料電池の湿潤状態を判定する湿潤状態判定手段と、該判定した湿潤状態に応じて前記水蒸気混在量調節手段を制御する制御手段とを備える。

【００１２】また、請求項３記載の燃料電池の燃料供給装置では、前記水蒸気混在量調節手段は、前記水素ガスの経路に設けられ、水素ガスが水蒸気とともに流入する緩衝容器と、該緩衝容器の内部温度を制御する温度制御部とを有する。

【００１３】この場合、請求項４記載の燃料電池の燃料供給装置では、前記緩衝容器は、前記燃料電池に供給される酸素含有ガスが通過する流体経路を容器内部との間で熱交換が行なえるように構成され、前記温度制御部は、前記流体経路を通過する前記酸素含有ガス量を制御するものである。

【００１４】

【作用】上記構成を有する請求項１記載の燃料電池の燃料供給装置では、まず、改質手段により炭化水素化合物を水蒸気改質し、水蒸気の混在状態で水素ガスを生成する。この生成された水素ガスは、供給手段により水蒸気とともに燃料電池に供給されるが、その経路において水蒸気混在量調節手段による水蒸気の除去を通して、水素ガス中の水蒸気混在量が確実に調節される。よって、燃料電池に供給される水素ガス中の水分は水滴化することなく水蒸気として混在するので、燃料電池には水滴として水が水素ガスとともに供給されることはない。

【００１５】請求項２記載の燃料電池の燃料供給装置では、運転状態検出手段の検出した燃料電池の運転状態に基づいて、湿潤状態判定手段により燃料電池の湿潤状態を判定する。そして、水素ガス中の水蒸気混在量を調節する水蒸気混在量調節手段を、制御手段により、燃料電池の湿潤状態に応じて制御するので、燃料電池の湿潤状態に応じて水素ガス中の水蒸気混在量を調節できる。よって、燃料電池の湿潤状態が水分過多であれば水蒸気混在量を少なく調節することで、水分過多を水蒸気としての水分で解消することができる。一方、水分不足であれば水蒸気混在量を多く調節することで、水分不足を水蒸気としての水分で解消することができる。

【００１６】請求項３記載の燃料電池の燃料供給装置では、水素ガスの経路に設けられた緩衝容器の内部温度を温度制御部により制御するので、緩衝容器に水蒸気とともに流入する水素ガス中の水蒸気を、この緩衝容器内で除去し、燃料電池に供給される水素ガス中の水蒸気混在量を調節する。

【００１７】請求項４記載の燃料電池の燃料供給装置では、緩衝容器を、燃料電池に供給される酸素含有ガスが通過する流体経路を緩衝容器内部との間で熱交換が行なえるよいに構成したものとし、温度制御部により、流体経路を通過する酸素含有ガス量を制御する。よって、酸素含有ガスとの熱交換を通して緩衝容器の内部温度を制御し、燃料電池に供給される水素ガス中の水蒸気混在量を調節する。このため、水素ガス中の水蒸気混在量の調節とともに、酸素含有ガスの温度をも調節できる。

【００１８】

【実施例】次に、本発明に係る燃料電池の燃料供給装置の好適な実施例について、図面に基づき説明する。図１は、実施例の燃料供給装置を適用した燃料電池システムのブロック図である。

【００１９】実施例の燃料電池システム１０は、固体高分子型燃料電池（以下、ＰＥＦＣと略称する）１２を中心に備え、ＰＥＦＣ１２には、酸素ガス供給管路１４からは酸素含有ガスである空気が、水素ガス供給管路１６からはメタノールを水蒸気改質して得られた水素ガスが、それぞれ供給される。水素ガス供給管路１６の管路には、水素ガス中の水蒸気混在量を調節するバッファータンク１８と、メタノール改質装置２０とが設けられている。なお、上記の両管路には適宜な箇所に逆流防止弁が設けられているが、本発明の要旨とは直接関係しないので図示されていない。

【００２０】ＰＥＦＣ１２は、固体高分子電解質膜を陽陰の電極で挟持して備え、陽極への空気と陰極への水素ガスとの供給を受けて陽陰の電極において上記の①，②の電極反応を進行させる。そして、ＰＥＦＣ１２は、当該電極反応を経て得られた起電力により、配線２２，２４を介して外部の駆動機器、例えば電気自動車におけるモータを駆動する。

【００２１】メタノール改質装置２０は、メタノールタンク２６から圧送ポンプ２８によりメタノールの供給を受け、水タンク３０から圧送ポンプ３２により水の供給を受ける。そして、メタノール改質装置２０は、改質触媒を介してメタノールと水との改質反応を２５０～３００℃の温度で進行させてメタノールを水蒸気改質し、高温（約２６０℃前後）の水素ガスを水蒸気の混在状態で生成する。この生成された水素ガスは、その下流のバッファータンク１８に送り出される。

【００２２】このように水タンク３０からメタノール改質装置２０に水を供給するに当たっては、以下に説明するように、メタノールに対してやや過多の量の水が供給されている。つまり、メタノール改質装置２０に供給された水がメタノール改質装置２０で水蒸気改質されて生成する水素ガス中に水蒸気として残存し、しかも残存量（水蒸気混在量）がＰＥＦＣ１２の駆動時（発電時）に必要となり得る最大水蒸気量よりも若干多くなるよう、メタノール改質装置２０への水の供給量が定められている。換言すれば、水素ガス温度が約２６０℃からＰＥＦＣ１２の運転温度（８０～１００℃）に近似した温度、例えば８０℃に降下しても、その温度における水素ガス中の水蒸気が飽和状態となり得る程度に、メタノールに対してやや過多の量の水が供給されている。

【００２３】メタノール改質装置２０から水素ガスが送り出されるバッファータンク１８は、タンク内部の温度を調節する温度調節機構を有し、後述する電子制御装置によるこの温度調節機構の運転制御を通して、タンク内部温度を制御する。この場合、バッファータンク１８には、メタノール改質装置２０から高温（約２６０℃前後）の水素ガスが送られており、バッファータンク１８からＰＥＦＣ１２に供給する水素ガス温度は、ＰＥＦＣ１２の運転温度（８０～１００℃）に近似した温度であることが望ましい。このため、バッファータンク１８は、水，空気等の冷却媒体を用いた温度調節機構として、次のような構成を備える。

【００２４】図２に示すように、バッファータンク１８は、金属製の本体容器部４０の上下端を、上部カバー部４２，下部カバー部４４で塞ぎ、これらをＯリング４６を介在させてボルト４８により水密に締め付けて形成されている。上部カバー部４２にはガス導入ポート５０が設けられており、当該ポートはメタノール改質装置２０と接続されている。また、上部カバー部４２にはガス排出ポート５２が設けられており、当該ポートはＰＥＦＣ１２と接続されている。このため、バッファータンク１８内部には、ガス導入ポート５０を経てメタノール改質装置２０から高温の水素ガスが水蒸気の混在状態で流入し、タンク内に流入した水素ガスはガス排出ポート５２を経てＰＥＦＣ１２に供給されることになる。更に、上部カバー部４２には、バッファータンク１８内部の温度を検出するタンク側温度センサ５３が取付固定されている。なお、このタンク側温度センサ５３は、後述の電子制御装置７０に接続されている。

【００２５】一方、下部カバー部４４には、バッファータンク内部で凝結して液化した水５４を排出するための水排出ポート５６が設けられおり、この水排出ポート５６は、図１に示すように循環用ポンプ５８を介在させて水循環管路６０により水タンク３０と接続されている。このため、バッファータンク１８内部に滞留した水５４は、循環用ポンプ５８により、水タンク３０に返送され、メタノール改質装置２０に供給する水として循環する。なお、上記した水の循環は、所定時間毎の循環用ポンプ５８の間歇駆動により、間歇的に行なわれている。

【００２６】本体容器部４０の側壁には、水や空気等の冷却媒体が通過する冷却媒体流路６２が容器内部を取り囲むよう形成されている。従って、図示しない流入口から冷却媒体が外部配管６３を経て冷却媒体流路６２に流入し、当該流路を冷却媒体が通過すれば、当該冷却媒体とバッファータンク１８内部の水素ガスとの間で熱交換が起きる。このため、冷却媒体流路６２を通過する冷却媒体の温度や通過量（単位時間当たり流量）の制御を通して、タンク内部温度を制御すること、即ち水素ガス温度を制御することが可能である。なお、この冷却媒体流路６２は、隣合う流路から独立して個別に形成しても良く、また、螺旋状に形成しても良い。

【００２７】本体容器部４０の内部には、タンク内部を上下に区画する多孔の隔壁６４が設けられており、この隔壁６４で区画された上部空間には、熱伝導率の高い金属またはセラミックの球状充填物６６が充填されてい

る。このため、ガス導入ポート５０を経て流入した水蒸気混在状態の高温の水素ガスと冷却媒体流路６２を通過する冷却媒体との熱交換は、隔壁６４上方の上部空間の球状充填物６６を介して効率よく行なわれる。また、本体容器部４０は、その外周において断熱材６８により被覆されており、本体容器部４０側壁から外部への熱の放出は遮断されている。

【００２８】従って、上記構造を有するバッファータンク１８に高温（約２６０℃前後）の水素ガスが水蒸気の混在状態で流入すると、この高温の水素ガスは、冷却媒体との熱交換を経てバッファータンク１８内部において冷却され、冷却媒体流路６２を通過する冷却媒体の温度やその通過量で規定される温度とされる。この水素ガスの冷却により、水素ガス中の水蒸気は、冷却後の水素ガス温度（タンク内部温度）における飽和水蒸気量を越える分についてバッファータンク１８内部において凝結して水滴となり、水素ガス中には、水蒸気が飽和状態で存在することになる。冷却媒体流路６２を通過する冷却媒体の流量は、電子制御装置からの制御信号により定まり、バッファータンク１８の冷却媒体流路６２に接続された外部配管６３に設けられた流量調整バルブ６５を駆動制御することで流量調整、即ちタンク内温度調節がなされる。なお、凝結した水滴は、隔壁６４の孔を通過して隔壁６４下方の下部空間に落下し、水排出ポート５６から水タンク３０に返送される。

【００２９】燃料電池システム１０は、この他、バッファータンク１８におけるタンク内部温度を制御するための電子制御装置７０と、ＰＥＦＣ１２における固体高分子電解質膜と電極（陰極）との接合部近傍の温度を検出する電池側温度センサ７２と、ＰＥＦＣ１２の出力電圧を検出する電圧計７４と、インピーダンスを検出するインピーダンス計７６とを備える。この電子制御装置７０は、ＣＰＵ，ＲＯＭ，ＲＡＭを中心に論理演算回路として構成され、これらとコモンバスを介して相互に接続された入力ポート及び出力ポートにより外部との入出力を行う。本実施例の燃料電池システム１０では、電子制御装置７０は、タンク側温度センサ５３，電池側温度センサ７２，電圧計７４およびインピーダンス計７６から、バッファータンク１８のタンク内部温度ＴTANK，ＰＥＦＣ１２の電解質膜近傍温度ＴPEFC，ＰＥＦＣ１２の出力電圧ＶおよびＰＥＦＣ１２のインピーダンスＺの入力を受け、バッファータンク１８の内部温度を調節すべく、バッファータンク１８の流量調整バルブ６５を駆動制御する。

【００３０】次に、上記した構成を備える本実施例の燃料電池システム１０において行なわれる燃料電池システム運転制御（ルーチン）について、図３のフローチャートに基づき説明する。図示するように、この燃料電池システム運転ルーチンは、まず、燃料電池システム１０のメインスイッチがＯＮであるかＯＦＦであるかを判断する（ステップＳ１００）。なお、このメインスイッチのＯＮ／ＯＦＦは、例えばバッテリの蓄電状態等に応じて制御用コンピュータから出力される指令信号で代用できるので、メインスイッチは機械的なスイッチに限定されるものではない。

【００３１】このステップＳ１００で肯定判断が下される場合には、この燃料電池システム１０がメインスイッチのＯＮを受けて当初のＯＮ状態に至ったシステムの立上げの場合と、このＯＮ状態が継続している定常運転継続中の場合とがある。よって、ステップＳ１００での肯定判断に続いては、燃料電池システム１０のＯＮ状態は既に所定期間に亘り継続している旨を示すフラグ（ＯＮ状態継続フラグＦON）の値が１であるか否かを判断する（ステップＳ１０５）。なお、このＯＮ状態継続フラグＦONは、最初の本ルーチンの実行に先立つ初期処理にて初期値０とされ、後述の本ルーチンの処理にて値０或いは値１とされる。

【００３２】ここで、ＯＮ状態継続フラグＦON≠１であれば、燃料電池システム１０がメインスイッチのＯＮを受けて当初のＯＮ状態に至ったシステム立上げ時なので、以下に記す複数の処理からなるシステム立上げ過渡期処理（ステップＳ１１０）に移行する。そして、当該処理が終了すれば「リターン」を抜けて上記処理を繰り返す。

【００３３】このステップＳ１１０のシステム立上げ過渡期処理では、図４に示すように、タンク側温度センサ５３と電池側温度センサ７２からバッファータンク１８のタンク内部温度ＴTANKとＰＥＦＣ１２の電解質膜近傍温度ＴPEFCを入力し（ステップＳ１１２）、その後、両温度を比較する（ステップＳ１１４）。即ち、タンク内部温度ＴTANKが電解質膜近傍温度ＴPEFCより高い温度であるか否かを判断する。

【００３４】ここで、肯定判断すれば、バッファータンク１８の内部温度の制御目標温度をステップＳ１１２で入力したＰＥＦＣ１２の電解質膜近傍温度ＴPEFCとし、電解質膜近傍温度ＴPEFCとタンク内部温度ＴTANKとの差に応じてバッファータンク１８の冷却媒体の流量調整バルブ６５を流量増大側に駆動制御する（ステップＳ１１６）。この際、流量調整バルブ６５にはＴPEFCとＴTANKとの温度差に応じた制御信号が出力され、温度差が大きいほど流量調整バルブ６５は多くの流量となるよう駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が温度差に応じて増大するので、タンク内部温度ＴTANKは降下することになる。なお、ステップＳ１１６に続いては、後述のステップＳ１２２が実行される。

【００３５】一方、ステップＳ１１４で否定判断した場合には、ＴPEFCとＴTANKとの差が所定値α以下であるか否かを判断する（ステップＳ１１８）。つまり、ステップＳ１１４で否定判断すればＴTANK≦ＴPEFCであるが、

その温度差が適正であるか、より詳細に説明すればタンク内部温度ＴTANKが電解質膜近傍温度ＴPEFCに比べて低すぎないかを判断する。このステップＳ１１８で肯定判断すれば、タンク内部温度ＴTANKは電解質膜近傍温度ＴPEFC以下でありその温度差は適正であるためにタンク内部温度ＴTANKを変更制御する必要がないとして、後述のステップＳ１２２に移行する。

【００３６】これに対して、ステップＳ１１８で否定判断すれば、タンク内部温度ＴTANKは電解質膜近傍温度ＴPEFC以下であるもののＴTANKはＴPEFCに比べて低すぎることになる。よって、タンク内部温度ＴTANKを電解質膜近傍温度ＴPEFCに近づくよう昇温させるべく、バッファータンク１８の冷却媒体の流量調整バルブ６５を流量減少側に駆動制御する（ステップＳ１２０）。この際、流量調整バルブ６５にはＴPEFCとＴTANKとの温度差に応じた制御信号が出力され、温度差が大きいほど流量調整バルブ６５は流量減となるよう駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が温度差に応じて減少するので、タンク内部温度ＴTANKは上昇することになる。

【００３７】そして、ステップＳ１１６，１１８およびステップＳ１２０に続いては、燃料電池システム１０がシステム立上げ過渡期にあるか或いは定常運転の継続中にあるか否かをメインスイッチがＯＮとされてからの経過時間等に基づき判断する（ステップＳ１２２）。ここで、否定判断すればいまだシステム立上げ過渡期であるとして、新たな処理を行なうことなく「リターン」を抜け、上記した各処理を繰り返す。

【００３８】一方、ステップＳ１２２で肯定判断すれば、燃料電池システム１０はシステム立上げ過渡期を脱して定常運転の継続中にあることになるので、ＯＮ状態継続フラグＦONに値１をセットする（ステップＳ１２４）。このようにＦON＝１とされると、その後の本ルーチンのステップＳ１０５で肯定判断されるので（図３参照）、このステップＳ１２４でＦONに値１がセットされるまでの間に亘って、上記したステップＳ１１２～１２４までの処理からなるシステム立上げ過渡期処理が繰り返し実行される。

【００３９】燃料電池システム１０がシステム立上げ過渡期にある間は、電解質膜近傍温度ＴPEFCはＰＥＦＣ１２の運転に伴って昇温する。よって、この間にステップＳ１１２～１２４からなるシステム立上げ過渡期処理を繰り返すことにより、バッファータンク１８は、そのタンク内部温度ＴTANKがＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより所定温度（α）だけ低い温度となるよう、当初の温度から昇温制御される。このため、燃料電池システム１０がシステム立上げ過渡期にある場合には、バッファータンク１８に流入した水素ガス（約２６０℃前後）は、冷却媒体との熱交換を経てＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより所定温度（α）だけ低い温度であるタンク内部温度ＴTANKとされるとともに、電解質膜近傍温度ＴPEFCの上昇に併せて上昇したタンク内部温度ＴTANKとされる。よって、バッファータンク１８において、水素ガス中の水蒸気は、ＴPEFC以下の温度における飽和状態とされ、過剰な水蒸気は凝結してバッファータンク１８内で水滴となる。また、ＰＥＦＣ１２に供給される水素ガス中の水蒸気量は、電解質膜近傍温度ＴPEFCの上昇に併せて増加することになる。

【００４０】従って、バッファータンク１８のガス排出ポート５２からは、水蒸気を飽和状態で混在した水素ガスがＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより所定温度（α）だけ低い温度でＰＥＦＣ１２に供給される。このため、燃料電池システム１０のシステム立上げ過渡期には、水分が水滴としてＰＥＦＣ１２に供給されることがないとともに、電池内部で水蒸気が凝結して水滴化することもない。しかも、ＰＥＦＣ１２の昇温に併せてバッファータンク１８内のタンク内部温度ＴTANKを高めていくことができる。

【００４１】このようにシステム立上げ過渡期処理のステップＳ１２４においてＦON＝１とされると、システム立上げ過渡期処理の終了時にあってもシステムＯＮであることと相俟って、次回の本ルーチンでは、ステップＳ１００の肯定判断に続くステップＳ１０５で肯定判断される。そして、この肯定判断を受けて、燃料電池システム１０はＯＮ状態が継続している定常運転継続中の状態にあるといえる。よって、この場合には、以下に記す複数の処理からなるシステム定常運転時処理（ステップＳ１３０）に移行し、当該処理が終了すれば「リターン」を抜けて上記処理を繰り返す。

【００４２】このステップＳ１３０のシステム定常運転時処理では、図５に示すように、まず、電圧計７４とインピーダンス計７６からＰＥＦＣ１２の出力電圧Ｖとインピーダンスを入力する（ステップＳ１３２）。

【００４３】ＰＥＦＣ１２の固体高分子電解質膜は適度な湿潤状態にあれば良好な電気伝導性（イオン導電性）を発揮することから、固体高分子電解質膜の含水率が過多となると、ＰＥＦＣ１２の出力は低下する。また、この電解質膜に接合する電極表面が水滴で閉塞されても、膜への水素ガスの透過が阻害されるのでやはりＰＥＦＣ１２の出力は低下する。つまり、この両者の場合は、電池内部の湿潤状態が水分過多の場合であり、この水分過多の状態に至るとＰＥＦＣ１２の出力電圧Ｖは低下する。しかも、このように水分過多となると、ＰＥＦＣ１２のインピーダンスＺは低下することが知られている。その反面、電池内部の湿潤状態が水分不足となって固体高分子電解質膜の含水率が低下すると、ＰＥＦＣ１２の出力電圧Ｖは低下するとともに、インピーダンスＺは上昇することが知られている。

【００４４】従って、ステップＳ１３２で入力したＰＥＦＣ１２の出力電圧ＶとインピーダンスＺとから、ステ

ップＳ１３２に続くステップＳ１３４では、ＰＥＦＣ１２内部の湿潤状態が適正であるか、水分過多（濡れすぎ）或いは水分不足（乾きすぎ）であるか否かを判断する。このステップＳ１３４で、電池内部の湿潤状態が適正であると判断すると、ＰＥＦＣ１２が適正な運転を継続していくためには、バッファータンク１８内のタンク内部温度ＴTANKの変更は必要ないとして、バッファータンク１８の冷却媒体の流量調整バルブ６５の流量を固定維持する（ステップＳ１３６）。よって、タンク内部温度ＴTANKは、電池内部の湿潤状態が適正状態にあると判断したときの温度に維持される。このため、バッファータンク１８においては、流入する水素ガス中の水蒸気は一定量が凝結して水滴化し、水素ガス中に混在する水蒸気量は定量となる。その後は、「リターン」を抜けて上記処理を繰り返す。

【００４５】一方、ステップＳ１３４で出力電圧Ｖとインピーダンスとからの湿潤状態が上記した水分過多であると判断した場合には、バッファータンク１８の冷却媒体の流量調整バルブ６５を流量増大側に駆動制御する（ステップＳ１３８）。この際、流量調整バルブ６５には、電池内部の湿潤状態が適正状態にあるときの出力電圧Ｖおよびインピーダンスと、ステップＳ１３２で入力した出力電圧Ｖおよびインピーダンスとを対比して得られる制御信号が出力され、水分過多の程度が大きいほど流量調整バルブ６５は多くの流量となるよう駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が水分過多の程度に応じて増大するので、タンク内部温度ＴTANKは降下することになる。この結果、バッファータンク１８においては、流入する水素ガス中の水蒸気は多くの量が凝結して水滴化し、水素ガス中に混在する水蒸気量は減少するので水素ガスにおける水蒸気量は以前より少なくなる。そして、ステップＳ１３６の後には、「リターン」を抜けて上記処理を繰り返す。

【００４６】このようにタンク内部温度ＴTANKを降下させるに当たっては、冷却媒体の流量増に伴うタンク内部温度ＴTANKの温度変化が電解質膜近傍温度ＴPEFCに対して最大－１０℃程度になるよう、冷却媒体流量が増大制御される。

【００４７】また、ステップＳ１３４で出力電圧Ｖとインピーダンスとからの湿潤状態が上記した水分不足であると判断した場合には、バッファータンク１８の冷却媒体の流量調整バルブ６５を流量減少側に駆動制御する（ステップＳ１４０）。この際、流量調整バルブ６５には、電池内部の湿潤状態が適正状態にあるときの出力電圧Ｖおよびインピーダンスと、ステップＳ１５２で入力した出力電圧Ｖおよびインピーダンスとを対比して得られる制御信号が出力され、水分不足の程度が大きいほど流量調整バルブ６５は流量減少側に駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が水分不足の程度に応じて減少するので、タンク内部温度ＴTANKは上昇することになる。この結果、バッファータンク１８においては、流入する水素ガス中の水蒸気は少量しか凝結して水滴化せず、水素ガス中に混在する水蒸気量はあまり減少しない。つまり、水素ガスにおける水蒸気量は以前より多くなる。そして、ステップＳ１４０の後には、「リターン」を抜けて上記処理を繰り返す。

【００４８】このようにタンク内部温度ＴTANKを上昇させるに当たっては、冷却媒体の流量増に伴うタンク内部温度ＴTANKの温度変化が電解質膜近傍温度ＴPEFCに対して最大＋５℃程度になるよう、冷却媒体流量が減少制御される。

【００４９】従って、ＰＥＦＣ１２が定常運転にある場合には、ステップＳ１３２～１４０からなる定常運転時処理が繰り返されるので、バッファータンク１８のタンク内部温度ＴTANKは、電池内部の湿潤状態に応じて温度制御される。このため、ＰＥＦＣ１２が定常運転状態にある場合には、バッファータンク１８に流入した水素ガス（約２６０℃前後）は、バッファータンク１８における冷却媒体との熱交換を経て温度制御されるので、水素ガス中の水蒸気は、バッファータンク１８における凝結を経てその混在量が電池内部の湿潤状態に応じて調節される。

【００５０】よって、バッファータンク１８のガス排出ポート５２からは、電池内部の湿潤状態が水分過多であれば、水蒸気混在量が以前より少ない水素ガスがＰＥＦＣ１２に供給されて水分過多が解消されることになる。また、水分不足であれば、水蒸気混在量が以前より多い水素ガスがＰＥＦＣ１２に供給されて水分不足が解消されることになる。そして、水分過多或いは水分不足が解消されれば、一定量の水蒸気を混在する水素ガスが継続してＰＥＦＣ１２に供給されることになる。

【００５１】しかも、このような水蒸気混在量の調節は、バッファータンク１８において水素ガス中の水蒸気の凝結・水滴化を経た水蒸気の除去を通して行なわれるので、ＰＥＦＣ１２に供給される水素ガス中には水分が水蒸気として混在し、ＰＥＦＣ１２には水分が水滴として水素ガスとともに供給されることはない。

【００５２】燃料電池システム１０がシステムのＯＮ状態にある時には、当該システムに含まれるＰＥＦＣ１２やメタノール改質装置２０，バッファータンク１８は上記したように駆動制御されているが、メインスイッチのＯＦＦや非常停止スイッチ等のＯＮ等を受けて、燃料電池システム１０はシステムのＯＮ状態からＯＦＦ状態に至る。すると、図３に示すように、本ルーチンのステップＳ１００では否定判断され、次のステップＳ１４５に移行する。

【００５３】燃料電池システム１０がＯＦＦ状態にある場合には、燃料電池システム１０が上記したＯＮ状態か

らＯＦＦ状態に推移した場合とシステムのＯＦＦ状態が継続している場合とがあり、この両者の場合であっても、ステップＳ１００で否定判断が下される。そこで、いずれのＯＦＦ状態であるかを判断すべく、ステップＳ１００の否定判断に続くステップＳ１４５では、ＯＮ状態継続フラグＦONの値が１であるか否かを、再度判断する。なお、システムがＯＦＦ状態にある場合には、システムを構成する総ての機器がＯＦＦとなっている場合の他、各機器、例えばＰＥＦＣ１２やメタノール改質装置２０，バッファータンク１８等がＯＦＦ状態にある場合も該当する。

【００５４】そして、このステップＳ１４５で否定判断（ＦON＝０）すれば、このＯＮ状態継続フラグＦONはシステムのＯＮの後のシステム立上げ過渡期処理においてしか値１とされないので、当初からＦON＝０のまま、即ち燃料電池システム１０のＯＦＦ状態は継続している場合である。よって、ステップＳ１４５で否定判断した場合には、「リターン」を抜けて上記処理を繰り返す。

【００５５】しかし、ステップＳ１４５で肯定判断した場合（ＦON＝１）には、燃料電池システム１０の状態がＯＮ状態からＯＦＦ状態に推移した場合であるので、以下に記す複数の処理からなるシステム停止過渡期処理（ステップＳ１５０）に移行する。そして、当該処理が終了すれば「リターン」を抜けて上記処理を繰り返す。このシステム停止過渡期処理は、メインスイッチのＯＦＦ後に、それまで運転中であった燃料電池システム１０をその再起動時を考慮して良好な状態で停止させることを目的とするものであり、このシステム停止過渡期にある間はＰＥＦＣ１２の電解質膜近傍温度ＴPEFCはメインスイッチのＯＦＦ後に徐々に降温（降下）することも考慮されている。

【００５６】より詳しく説明すると、ＰＥＦＣ１２やメタノール改質装置２０，バッファータンク１８等の燃料電池システム１０の各構成機器をメインスイッチのＯＦＦ後に総て一律にＯＦＦとするのではない。そして、各構成機器を一律にＯＦＦとしないことで、当該スイッチのＯＦＦに連動して停止するメタノール改質装置２０から水蒸気を混在した残ガスがＰＥＦＣ１２に流入してＰＥＦＣ１２内で水蒸気が凝結することを防止するとともに、その残ガス中の余分な水蒸気の除去を図るために、メインスイッチのＯＦＦ後もしばらくの間、バッファータンク１８のタンク内部温度ＴTANKをＰＥＦＣ１２の電解質膜近傍温度ＴPEFCの低下に併せて低下させるよう制御するのである。

【００５７】即ち、このステップＳ１５０のシステム停止過渡期処理では、図６に示すように、システム立上げ過渡期処理におけるステップＳ１１２～１２０までと同様、タンク内部温度ＴTANKを電解質膜近傍温度ＴPEFCの降下に追従して制御する。まず、タンク内部温度ＴTANKと電解質膜近傍温度ＴPEFCを入力し（ステップＳ１５２）、その後、両温度を比較して（ステップＳ１５４）、タンク内部温度ＴTANKが電解質膜近傍温度ＴPEFCより高い温度であるか否かを判断する。

【００５８】ここで、肯定判断すれば、バッファータンク１８の内部温度の制御目標温度をステップＳ１５２で入力したＰＥＦＣ１２の電解質膜近傍温度ＴPEFCとし、電解質膜近傍温度ＴPEFCとタンク内部温度ＴTANKとの差に応じてバッファータンク１８の冷却媒体の流量調整バルブ６５を流量増大側に駆動制御する（ステップＳ１５６）。この際、流量調整バルブ６５にはＴPEFCとＴTANKとの温度差に応じた制御信号が出力され、温度差が大きいほど流量調整バルブ６５は多くの流量となるよう駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が温度差に応じて増大するので、タンク内部温度ＴTANKは降下することになる。なお、ステップＳ１５６に続いては、後述のステップＳ１６２が実行される。

【００５９】一方、ステップＳ１５４で否定判断した場合には、ＴPEFCとＴTANKとの差が所定値α以下であるか否かを判断する（ステップＳ１５８）。つまり、ステップＳ１５４で否定判断すればＴTANK≦ＴPEFCであるが、その温度差が適正であるか、より詳細に説明すればタンク内部温度ＴTANKが電解質膜近傍温度ＴPEFCに比べて低すぎないかを判断する。このステップＳ１５８で肯定判断すれば、タンク内部温度ＴTANKは電解質膜近傍温度ＴPEFC以下でありその温度差は適正であるためにタンク内部温度ＴTANKを変更制御する必要がないとして、後述のステップＳ１６２に移行する。

【００６０】これに対して、ステップＳ１５８で否定判断すれば、タンク内部温度ＴTANKは電解質膜近傍温度ＴPEFC以下であるもののＴTANKはＴPEFCに比べて低すぎることになる。よって、タンク内部温度ＴTANKを電解質膜近傍温度ＴPEFCに近づくよう昇温させるべく、バッファータンク１８の冷却媒体の流量調整バルブ６５を流量減少側に駆動制御する（ステップＳ１６０）。この際、流量調整バルブ６５にはＴPEFCとＴTANKとの温度差に応じた制御信号が出力され、温度差が大きいほど流量調整バルブ６５は流量減となるよう駆動制御される。このため、バッファータンク１８の冷却媒体流路６２を通過する冷却媒体の流量が温度差に応じて減少するので、タンク内部温度ＴTANKは上昇することになる。

【００６１】そして、ステップＳ１５６，１５８およびステップＳ１６０に続いては、燃料電池システム１０がシステム停止過渡期にあるか或いは停止継続中にあるか否かをメインスイッチがＯＦＦとされてからの経過時間等に基づき判断する（ステップＳ１６２）。ここで、否定判断すればいまだシステム停止過渡期であるとして、新たな処理を行なうことなく「リターン」を抜け、上記した各処理を繰り返す。

【００６２】一方、ステップＳ１６２で肯定判断すれ

ば、燃料電池システム１０はシステム停止過渡期を脱して停止継続中に至ったこと或いは当初から停止継続中であることになるので、ＯＮ状態継続フラグＦONに値０をセットする（ステップＳ１６４）。このようにＦON＝０とされると、その後の本ルーチンのステップＳ１０５では否定判断されるので（図３参照）、このステップＳ１６４でＦONに値０がセットされるまでの間に亘って、上記したステップＳ１５２～１６４までの処理からなるシステム停止過渡期処理が繰り返し実行される。

【００６３】従って、燃料電池システム１０がシステム停止過渡期にある間には、ステップＳ１５２～１６４からなるシステム停止過渡期処理が繰り返されこの間は電解質膜近傍温度ＴPEFCは徐々に低下するので、バッファータンク１８は、そのタンク内部温度ＴTANKがＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより所定温度（α）だけ低い温度となるよう運転継続中の温度から降温制御される。このため、メインスイッチのＯＦＦ等を受けてシステムがＯＦＦ状態とされた場合には、バッファータンク１８に流入した残ガスは、冷却媒体との熱交換を経てＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより低い温度であるタンク内部温度ＴTANKとされる。しかも、この場合には、電解質膜近傍温度ＴPEFCは徐々に降下する。よって、バッファータンク１８に流入した残ガスは、電解質膜近傍温度ＴPEFCの降下に併せて降下したタンク内部温度ＴTANKとされる。この結果、バッファータンク１８において、残ガス中の水蒸気は、ＴPEFCより低い温度における飽和状態とされ、過剰な水蒸気は凝結してバッファータンク１８内で水滴となり水素ガス供給管路１６の経路外に除去される。また、ＰＥＦＣ１２に供給される残ガス中の水蒸気量は、電解質膜近傍温度ＴPEFCの降下に併せて減少することになる。

【００６４】よって、バッファータンク１８のガス排出ポート５２からは、水蒸気を飽和状態で混在した残ガスがその時のＰＥＦＣ１２の電解質膜近傍温度ＴPEFCより所定温度（α）だけ低い温度でＰＥＦＣ１２に供給される。このため、システム停止の場合には、水分が水滴として供給されることがないとともに、ＴPEFC＞ＴTANKであることから電池内部で水蒸気が凝結して水滴化することもない。従って、システム停止の場合には、電池内部に水分が水滴として残存することがない。

【００６５】以上説明したように本実施例の燃料電池の燃料供給装置では、ＰＥＦＣ１２に水分を水蒸気として供給する水素ガス中の水蒸気混在量の調節を、バッファータンク１８のタンク内部温度ＴTANKの調節を経た水蒸気の除去を通して行なう。この結果、本実施例の燃料電池の燃料供給装置によれば、水素ガス中の水蒸気混在量の調節を確実に行なうことができ、燃料電池の出力の安定化を図ることができる。

【００６６】また、本実施例の燃料電池の燃料供給装置では、システム停止の場合に、ＰＥＦＣ１２に水分を水滴として供給せず、しかもＰＥＦＣ１２におけるガス中の水蒸気の凝結を回避する。このため、本実施例の燃料電池の燃料供給装置によれば、システム停止の場合に、電池内部に水分が水滴として残存することがなくＰＥＦＣ１２の固体高分子電解質膜/電極接合体の界面に塗布された触媒の劣化や、ＰＥＦＣ１２におけるガス配管の腐食等を確実に回避することができる。

【００６７】また、システム停止の場合にあっても、水蒸気として水分を供給する。よって、本実施例の燃料電池の燃料供給装置によれば、不用意な固体高分子電解質膜のいわゆるドライアップを回避し、再起動時における始動特性を向上させることができる。

【００６８】更に、本実施例の燃料電池の燃料供給装置では、システムの立上げ過渡期に、ＰＥＦＣ１２に水分を水滴として供給せず、しかもＰＥＦＣ１２における水素ガス中の水蒸気の凝結を回避する。このため、本実施例の燃料電池の燃料供給装置によれば、ＰＥＦＣ１２の固体高分子電解質膜に接合する電極表面を水滴で閉塞することがなく膜への水素ガスの透過を阻害しないので、始動特性を向上させることができるとともに、起動初期から早期のうちに適正な出力電圧を得ることができる。

【００６９】また、システムの立上げ過渡期には、水素ガス中の水蒸気を飽和状態でかつその量を電解質膜近傍温度ＴPEFCの上昇に併せて増加させる。よって、本実施例の燃料電池の燃料供給装置によれば、電解質膜近傍温度ＴPEFCの上昇の間に亘っての電池内部の湿潤状態の適正化を通して、ＰＥＦＣ１２をより速く定常運転にすることができる。

【００７０】加えて、本実施例の燃料電池の燃料供給装置では、ＰＥＦＣ１２が定常運転にある場合にあっても、ＰＥＦＣ１２には水分を水滴として供給せず、ＰＥＦＣ１２の固体高分子電解質膜への水分補給を飽和状態の水蒸気で賄う。このため、本実施例の燃料電池の燃料供給装置によれば、ＰＥＦＣ１２の固体高分子電解質膜に接合する電極表面を水滴で閉塞することがなく膜への水素ガスの透過を阻害しないので、定常運転時における電極反応の円滑な進行を通して安定した出力を得ることができる。

【００７１】また、本実施例の燃料電池の燃料供給装置では、ＰＥＦＣ１２が定常運転にある場合に、水素ガス中の水蒸気の混在量を電池内部の湿潤状態に応じて調節する。このため、本実施例の燃料電池の燃料供給装置によれば、電池内部が水分過多や水分不足に至ってＰＥＦＣ１２の出力が低下しても、水素ガス中の水蒸気混在量の調整を通してこの水分過多や水分不足を解消し、安定した出力を得ることができる。

【００７２】ここで、上記した本実施例の燃料供給装置と水蒸気混在量の調節を行なわず水蒸気混在量が一定（定常状態に必要な水蒸気混在量）の水素ガスを供給する燃料供給装置（従来例）との評価試験について説明す

る。この評価試験は、ＰＥＦＣ１２の定常運転時の出力（電流値）を１００とした場合、その出力を起動からの経過時間毎に測定することで行なった。その結果を図７に示す。

【００７３】この図７から明らかなように、本実施例の燃料供給装置によれば、起動時からスムースに出力が上昇し、１５分を経過すれば定常時の約９０％の出力を得ることができた。しかも、３０分経過後にはほぼ１００％の出力を継続して得ることができた。しかしながら、従来例では、起動初期には急激に出力が立ち上がるものの１０分経過後からは徐々に出力が低下した。しかも、１０分経過時点の出力は定常時の約６７％に過ぎなかった。よって、本実施例の燃料供給装置によれば、安定した出力を得ることができることが判明した。なお、従来例の燃料供給装置で観察された出力の様子は、以下のように説明できる。

【００７４】従来例では、水蒸気混在量が調節されていないので、燃料電池にはその温度が低いものの大量の水蒸気が供給される。このため、一時的にセル抵抗が低下して急激に出力が上がる。しかし、その後は、過剰な水蒸気が燃料電池内部で凝結して水滴化し、電極を閉塞したりセル抵抗の上昇を招く。このため、定常時の出力まで上昇することなく徐々に出力が低下する。

【００７５】また、本実施例の燃料電池の燃料供給装置によれば、次のような利点がある。即ち、本実施例の燃料電池の燃料供給装置では、バッファータンク１８で水蒸気が水滴化した水を、循環用ポンプ５８により水循環管路６０を経て水タンク３０に返送し、メタノール改質装置２０に供給する水として循環させる。このため、本実施例の燃料電池の燃料供給装置によれば、水の利用効率を高めることができる。

【００７６】次に、他の実施例について説明する。まず、第２実施例の燃料供給装置について説明する。この第２実施例の燃料供給装置は、上記した燃料電池システム１０におけるバッファータンク１８の冷却媒体を酸素ガス供給管路１４を経てＰＥＦＣ１２に供給される酸素含有ガス（空気）とした点で、その構成が相違する。即ち、図８に示すように、ＰＥＦＣ１２に空気を供給する酸素ガス供給管路１４には、その上流側から空気の圧送ポンプ８０が設けられており、当該ポンプの下流においては、この酸素ガス供給管路１４は、バッファータンク１８の下流で合流する分岐管路１４ａ，１４ｂとされている。各分岐管路１４ａ，１４ｂには、当該管路を通過する流量を調整する流量調整バルブ８１，８２が設けられている。なお、圧送ポンプ８０としてはコンプレッサーによる大気加圧供給装置を例示することができる。また、圧送ポンプ８０の外には、例えば高圧空気ガスボンベや液体空気タンクを用いたガス供給装置を用いることもできる。

【００７７】流量調整バルブ８２が設けられた側の分岐管路１４ｂは、バッファータンク１８の外部配管６３（図２参照）と接続されており、この分岐管路１４ｂを通過する空気がバッファータンク１８の冷却媒体流路６２を通する間に水素ガスとの熱交換に供される。また、この酸素ガス供給管路１４には、管路を通過する空気を加湿する加湿器８３が各分岐管路の合流点下流に設けられている。なお、この加湿器８３は、管路を通過する空気を加湿することができればいかような構成でも良く、バブリング法による加湿器の他、水を直接ガス気流中で霧化する方式の加湿器や、気体状の水（水蒸気）は通すが液体状の水は通さない多孔質膜を用いて加湿する方式の加湿器など、いずれの加湿器を採用しても良い。このように加湿器８３により加湿することで空気温度が低下する場合には、加熱手段を加湿器と併用することにより、ＰＥＦＣ１２には所定温度まで昇温させた空気を供給することができる。

【００７８】上記構成の第２実施例の燃料供給装置では、電子制御装置７０からの制御信号により各分岐管路１４ａ，１４ｂの流量調整バルブ８１，８２を駆動制御することで、例えばその流量比を制御することで、バッファータンク１８の冷却媒体流路６２を通過する空気の流量を調節できる。このため、第２実施例の燃料供給装置によれば、バッファータンク１８のタンク内部温度の調節を通した水素ガス中の水蒸気混在量の調節による燃料電池出力の安定化に加え、ＰＥＦＣ１２にはバッファータンク１８で昇温させた空気を供給できる。よって、空気温度の昇温調節を通して、より一層電極反応を円滑化させて安定した出力を得ることができる。また、ＰＥＦＣ１２に供給する空気を昇温させるための特別な装置を必要とせず、構成の簡略化を図ることができる。

【００７９】次に、第３実施例の燃料供給装置について説明する。この第３実施例の燃料供給装置は、上記した燃料電池システム１０におけるバッファータンク１８の冷却媒体をＰＥＦＣ１２の冷却水とした点で、その構成が相違する。即ち、図９に示すように、ＰＥＦＣ１２の図示しない冷却水流路に冷却水を循環供給する冷却水循環管路８４には、電池側温度センサ７２（図１参照）の検出したＰＥＦＣ１２の電解質膜近傍温度ＴPEFCに応じて冷却水循環管路８４の冷却水流量を調整する冷却水ポンプ８５と、当該管路の冷却水を放熱を通して所定温度に冷却（維持）する放熱器８６とが設けられている。また、冷却水循環管路８４には、バッファータンク１８の外部配管６３（図２参照）に接続されたタンク冷却水循環管路８７が、冷却水ポンプ８５の下流で冷却水循環管路８４から分岐し放熱器８６の上流で冷却水循環管路８４と合流するよう設けられている。そして、このタンク冷却水循環管路８７には、当該管路を通過する流量を調整する流量調整バルブ８８が設けられている。

【００８０】従って、タンク冷却水循環管路８７を通過する燃料電池冷却水がバッファータンク１８の冷却媒体

流路６２を通する間に水素ガスとの熱交換に供される。このため、第３実施例の燃料供給装置では、電子制御装置７０からの制御信号によりタンク冷却水循環管路８７の流量調整バルブ８８を駆動制御することで、バッファータンク１８の冷却媒体流路６２を通過する冷却水の流量を調節できる。この結果、第３実施例の燃料供給装置によれば、既述した第１実施例と同様に、バッファータンク１８のタンク内部温度の調節を通して水素ガス中の水蒸気混在量を調節し、燃料電池出力の安定化を図ることができる。また、バッファータンク１８における熱交換媒体の供給を行なうためだけの特別な装置を必要とせず、構成の簡略化を図ることができる。

【００８１】次に、第４実施例の燃料供給装置について説明する。この第４実施例の燃料供給装置は、熱交換により水素ガス中の水蒸気を凝結・水滴化して水素ガス中の水蒸気混在量を調整するバッファータンク１８に代わり、吸水性高分子樹脂や多孔質体粒子等を内蔵しこれらにガス中の水蒸気を吸着して水素ガス中の水蒸気を除去する除湿装置を用いた点で、その構成が相違する。即ち、図１０に示すように、ＰＥＦＣ１２に水素ガスを供給する水素ガス供給管路１６は、メタノール改質装置２０とＰＥＦＣ１２との間において、メタノール改質装置２０の下流で分岐しＰＥＦＣ１２手前で合流する分岐管路１６ａ，１６ｂとされている。各分岐管路１６ａ，１６ｂには、当該管路を通過する流量を調整する流量調整バルブ８９，９０が設けられている。そして、分岐管路１６ｂには、流量調整バルブ９０の下流にガス中の水蒸気を吸着して水素ガス中の水蒸気を除去する除湿装置９１が設けられている。この除湿装置９１は、内蔵する吸水性高分子樹脂等の量や性質により、当該装置を通過する水素ガスの単位流量当たり一定の水蒸気を除湿する能力を有する。このため、除湿装置９１を通過する水素ガスの流量を変えることで、水蒸気除去量を調節することができる。

【００８２】上記構成の第４実施例の燃料供給装置では、電子制御装置７０からの制御信号により各分岐管路１６ａ，１６ｂの流量調整バルブ８９，９０を駆動制御することで、例えばその流量比を制御することで、各分岐管路が合流してＰＥＦＣ１２に至る水素ガス中の水蒸気混在量を除湿装置９１による水蒸気除去を通して調節できる。このため、第４実施例の燃料供給装置によれば、燃料電池出力の安定化を図ることができる。なお、分岐管路１６ａにも、流量調整バルブ８９の下流に分岐管路１６ｂの除湿装置９１と異なる除湿能力を有する除湿装置を設け、電子制御装置７０からの制御信号により各分岐管路１６ａ，１６ｂの流量調整バルブ８９，９０を駆動制御するよう構成することもできる。

【００８３】以上本発明の一実施例について説明したが、本発明はこの様な実施例になんら限定されるものではなく、本発明の要旨を逸脱しない範囲において種々なる態様で実施し得ることは勿論である。

【００８４】例えば、システム停止過渡期処理において、タンク内部温度ＴTANKを電解質膜近傍温度ＴPEFC以下でその温度差が適正（α）となるよう降温制御したが（ステップＳ１５８，１６０）、タンク内部温度ＴTANKを電解質膜近傍温度ＴPEFC以下の温度となるよう降温制御するよう構成することもできる。つまり、システム停止過渡期処理におけるステップＳ１５８を省略し、ステップＳ１５４で否定判断した場合にはステップＳ１６０に移行すればよい。

【００８５】なお、上記した実施例では、水素ガス中の水蒸気混在量を水素ガス管路中から除去することで調節したが、燃料電池の出力の安定化を図るには、水蒸気除去と水蒸気混入を併用して次のように構成することもできる。

【００８６】即ち、水素ガスを燃料ガスとする燃料電池に該水素ガスを供給する燃料供給装置であって、炭化水素化合物を水蒸気改質して、水素ガスを水蒸気の混在状態で生成する改質手段と、該生成された水素ガスを前記水蒸気とともに前記燃料電池に供給する供給手段と、前記燃料電池の運転状態を検出する運転状態検出手段と、該検出した運転状態に基づいて前記燃料電池の湿潤状態を判定する湿潤状態判定手段と、前記燃料電池に供給される水素ガス中の水蒸気混在量を、前記判定した湿潤状態に応じて増減調節する水蒸気混在量増減調節手段とを備える。

【００８７】この場合、水蒸気混在量を増減調節する水蒸気混在量増減調節手段は、上記した各実施例におけるバッファータンク１８や除湿装置９１等の水蒸気除去装置と、加湿装置等の水蒸気混入装置を併用することで実現される。

【００８８】この燃料電池の燃料供給装置では、燃料電池に供給される水素ガス中の水蒸気混在量を調節するに当たり、水素ガス中に水蒸気を混入したり除去することで水蒸気混在量を増減調節する。そして、この増減調整を燃料電池の運転状態に基づいて判定した燃料電池の湿潤状態に応じて行なう。このため、燃料電池の湿潤が過多であれば、供給される水素ガス中の水蒸気混在量を、水蒸気の除去により少なめに調節して湿潤過多を回避することができる。一方、燃料電池の湿潤が不足していれば、供給される水素ガス中の水蒸気混在量を、水蒸気の添加により多めに調節して湿潤不足を回避することができる。この結果、常に燃料電池を好適な湿潤状態におくことを通して、安定した出力を得ることができる。

【００８９】

【発明の効果】以上詳述したように請求項１ないし請求項４記載の燃料電池の燃料供給装置では、燃料電池に水分を水蒸気として供給する水素ガス中の水蒸気混在量の調節を水蒸気の除去を通して確実に行なう。この結果、本発明の燃料電池の燃料供給装置によれば、燃料電池を

常に好適な湿潤状態におくことができ、燃料電池の出力の安定化を図ることができる。また、加湿器等を別途必要としないので、その構成の簡略化を図ることもできる。

【0090】しかも、請求項1ないし請求項4記載の燃料電池の燃料供給装置では、燃料電池には水分を水滴として供給せず、燃料電池への水分補給を飽和状態の水蒸気で賄う。この結果、請求項1ないし請求項4記載の燃料電池の燃料供給装置によれば、燃料電池における電極を水滴で閉塞することがなく、電解質膜への水素ガスの透過を阻害しないので、電極反応の円滑な進行を通して安定した出力を得ることができる。

【0091】請求項2記載の燃料電池の燃料供給装置では、燃料電池に供給される水素ガス中の水蒸気の混在量を燃料電池の湿潤状態に応じて調節する。このため、請求項2記載の燃料電池の燃料供給装置によれば、電池内部が水分過多や水分不足に至って出力が低下しても、水素ガス中の水蒸気混在量の調整を通してこの水分過多や水分不足を解消し、安定した出力を得ることができる。

【0092】請求項4記載の燃料電池の燃料供給装置では、燃料電池に供給される酸素含有ガスとの熱交換を通して緩衝容器の内部温度を制御し、燃料電池に供給される水素ガス中の水蒸気混在量を調節する。このため、請求項4記載の燃料電池の燃料供給装置によれば、水素ガス中の水蒸気混在量の調節に加え、酸素含有ガスの温度をも調節することができるので、電極反応のより一層の円滑化を通して出力の安定化を図ることができる。また、燃料電池に供給する酸素含有ガスを昇温させるための特別な装置を必要とせず、構成の簡略化を図ることができる。

【図面の簡単な説明】

【図1】第1実施例の燃料供給装置を適用した燃料電池システムのブロック図。

【図2】第1実施例の燃料供給装置におけるバッファータンク18の概略断面図。

【図3】燃料電池システム10において行なわれる燃料電池システム運転ルーチンのフローチャート。

【図4】燃料電池運転ルーチンにおけるシステム立上げ過渡期処理の詳細フローチャート。

【図5】燃料電池運転ルーチンにおける定常運転時処理の詳細フローチャート。

【図6】燃料電池運転ルーチンにおけるシステム停止過渡期処理の詳細フローチャート。

【図7】実施例の燃料供給装置と従来例の燃料供給装置との評価の結果を示すグラフ。

【図8】第2実施例の燃料供給装置を適用した燃料電池システムの要部ブロック図。

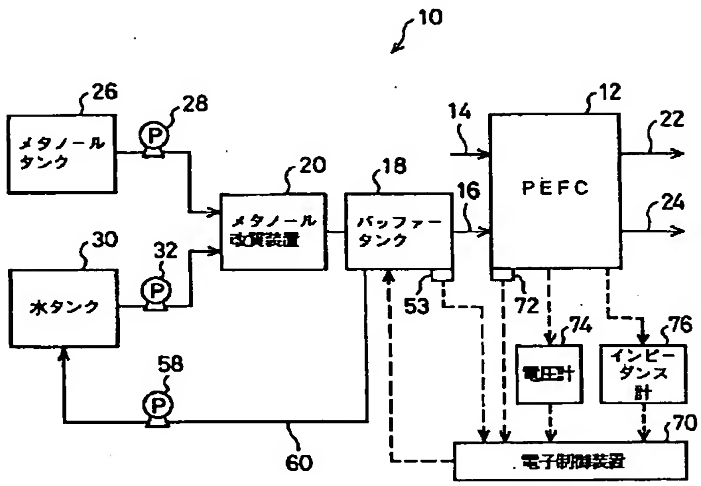
【図9】第3実施例の燃料供給装置を適用した燃料電池システムの要部ブロック図。

【図10】第4実施例の燃料供給装置を適用した燃料電池システムの要部ブロック図。

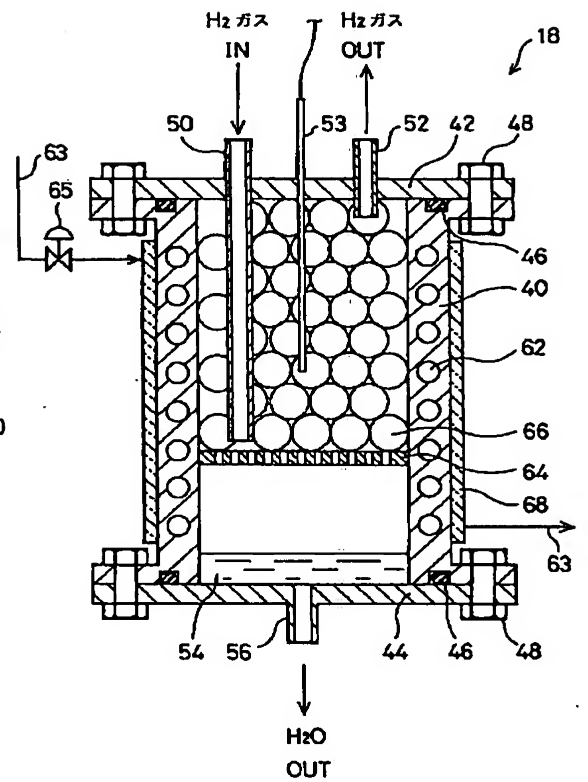
【符号の説明】

10…燃料電池システム
12…PEFC
14…酸素ガス供給管路
14a，14b…分岐管路
16…水素ガス供給管路
16a，16b…分岐管路
18…バッファータンク
20…メタノール改質装置
26…メタノールタンク
28…圧送ポンプ
30…水タンク
32…圧送ポンプ
53…タンク側温度センサ
58…循環用ポンプ
60…水循環管路
62…冷却媒体流路
63…外部配管
65…流量調整バルブ
66…球状充填物
70…電子制御装置
72…電池側温度センサ
74…電圧計
76…インピーダンス計
80…圧送ポンプ
81，82…流量調整バルブ
83…加湿器
84…冷却水循環管路
85…冷却水ポンプ
86…放熱器
87…タンク冷却水循環管路
88…流量調整バルブ
89，90…流量調整バルブ
91…除湿装置

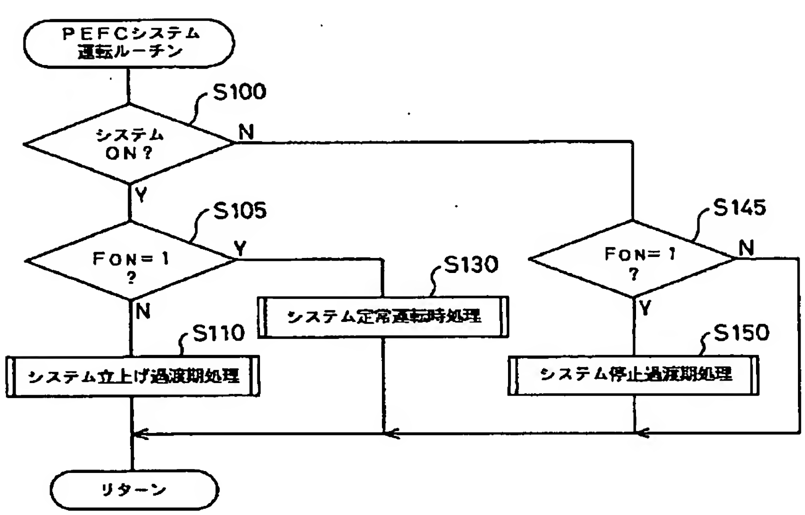
【図1】


10
26
メタノール
タンク
28
P
20
メタノール
改質装置
18
バッファー
タンク
14
12
PEFC
22
16
24
30
水タンク
32
P
53
72
74
電圧計
76
インピー
ダンス
計
58
P
60
70
電子制御装置

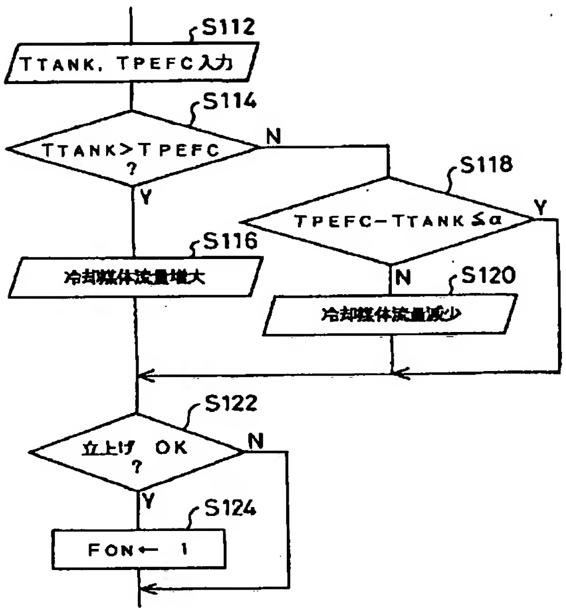
【図2】


H_2ガス
IN
H_2ガス
OUT
18
50
53
52
42
48
63
65
46
40
62
66
64
68
63
54
56
44
46
48
H_2O
OUT

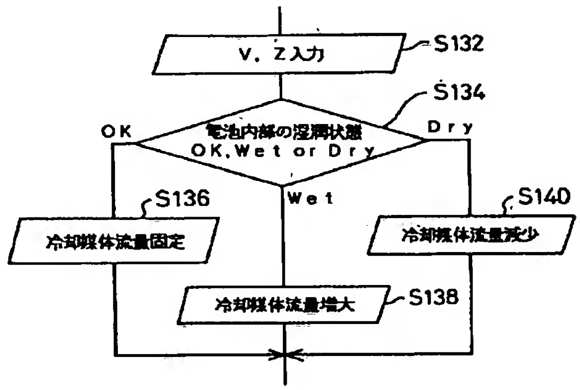
【図3】


PEFCシステム
運転ルーチン
S100
システム
ON？
N
Y
S105
$F_{ON}=1$
？
Y
S130
システム定常運転時処理
N
S110
システム立上げ過渡期処理
S145
$F_{ON}=1$
？
N
Y
S150
システム停止過渡期処理
リターン

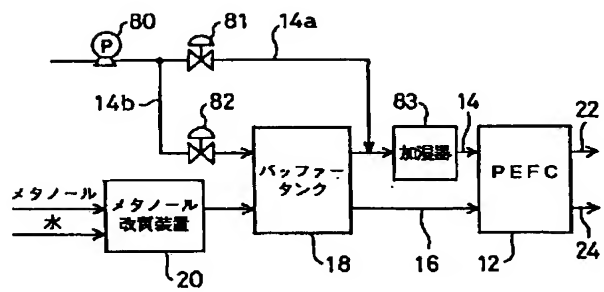
【図4】


S112
TTANK, TPEFC入力
S114
TTANK>TPEFC
?
N
Y
S118
TPEFC－TTANK≦α
Y
S116
冷却媒体流量増大
N
S120
冷却媒体流量減少
S122
立上げ OK
?
N
Y
S124
FON← 1

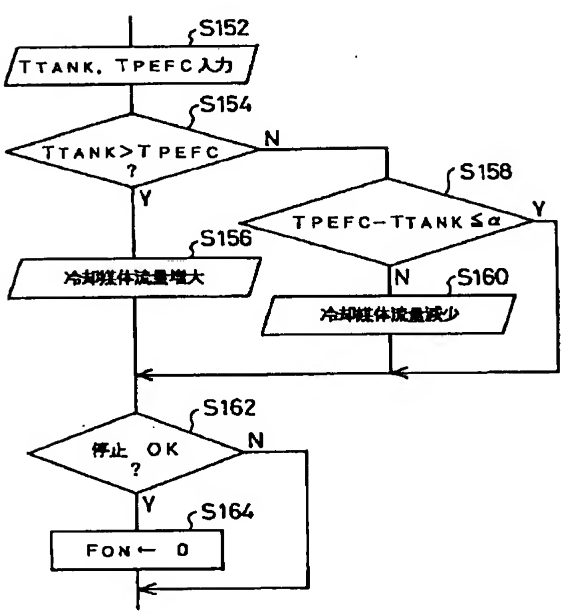
【図5】


V, Z入力
S132
S134
OK
電池内部の湿潤状態
OK, Wet or Dry
Dry
S136
Wet
S140
冷却媒体流量固定
冷却媒体流量減少
冷却媒体流量増大
S138

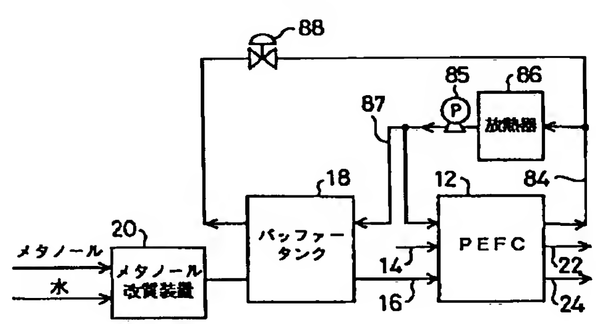
【図8】


80
81
14a
14b
82
83
14
22
加湿器
バッファータンク
PEFC
メタノール
水
メタノール改質装置
20
18
16
12
24

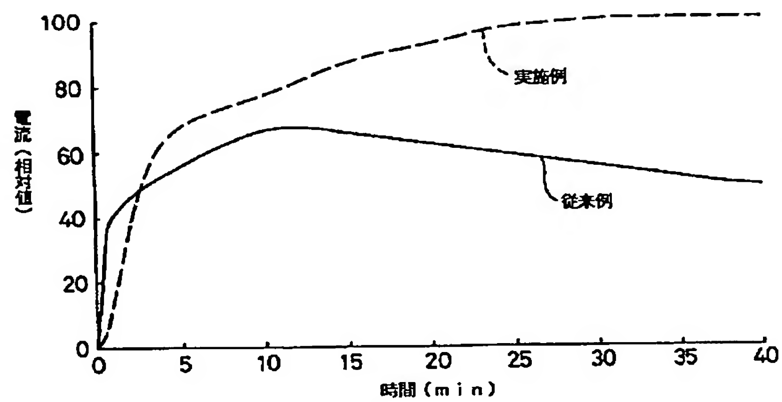
【図6】


S152
TTANK, TPEFC入力
S154
TTANK>TPEFC
?
N
Y
S158
TPEFC－TTANK≦α
Y
S156
冷却媒体流量増大
N
S160
冷却媒体流量減少
S162
停止 OK
?
N
Y
S164
FON← 0

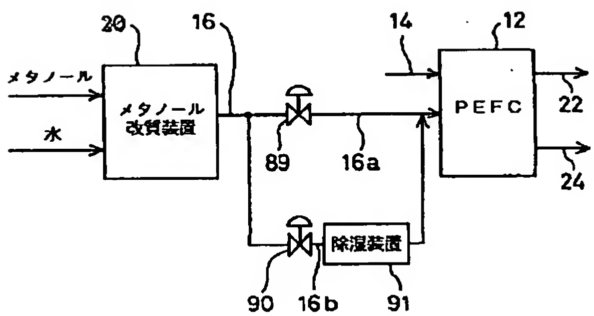
【図9】


88
85
86
87
放熱器
18
12
84
20
バッファータンク
PEFC
メタノール
水
メタノール改質装置
14
16
22
24

【図7】


100
80
60
40
20
0
電流（相対値）
0
5
10
15
20
25
30
35
40
時間（min）
実施例
従来例

【図10】


20
16
14
12
メタノール
水
メタノール
改質装置
PEFC
22
24
89
16a
除湿装置
90
16b
91